ISSN 0972-2378

भाकृ अनुप
ICAR

CMFRI

वार्षिक प्रतिवेदन
Annual Report
2005-06

Annual Report

2005-2006

भाकृ अनुप
ICAR

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
Post Box No. 1603, Ernakulam North P.O., Cochin - 682 018, India

CMFRI Annual Report 2005-2006

Published by
Prof. (Dr.) Mohan Joseph Modayil
Director

Editors
Dr. E.V. Radhakrishnan
Dr. P. Jayasankar

Hindi Translation
Mrs. P.J. Sheela

Word Process and Secretarial Assistance
Ms. G. Manjusha Menon
Mrs. K. V. Sajitha
Mrs. N.R. Letha Devi

Printed at
Niseema Printers & Publishers
SRM Road, Cochin - 18
Ph : 2403760, 2402948

Open sea cage culture - CMFRI has initiated research-cum-demonstration at four locations along the Indian coast

Cover design & Layout : - Prof. (Dr.) Mohan Joseph Modayil

ISSN 0972-2378

Citation: CMFRI. 2006. *Annual Report 2005-2006*. Central Marine Fisheries Research Institute, Cochin, 141 p.

CONTENTS

PREFACE

Marine fisheries is basically harnessing a natural resource and therefore management for ensuring resource resilience and sustainability must anchor on knowledge-based interventions generated through monitoring of their distribution, abundance, population dynamics and fluctuations in relation to natural factors and anthropogenic activities. The major mandates of the CMFRI are to monitor the exploited marine fisheries resources of our coasts and develop appropriate management and governance interventions for ensuring sustainability as well as to develop and field test commercially viable technologies for mariculture of economically important fin and shell fishes. The Institute has been able to make significant contributions in the above two areas during the past year 2005-06 by implementing 31 in-house projects, 21 sponsored projects and 9 consultancy projects. During the last SRC of the Institute, several projects were merged and made multi-divisional with focus on regional issues in capture fisheries. This resulted in consolidating and strengthening of the research efforts as well as reduction in the total number of in-house projects to 31 from the earlier 51.

A major achievement during the current year was completion of the Marine Fisheries Census 2005 which was carried out in 8 maritime states covering 2580 villages and 547241 fisher households for generating primary data on the number of fishing villages, landing centres, fishermen population, demography, fishing crafts & gears, socio-economic status, earnings, livelihoods etc. This comprehensive data base is a milestone in the development of marine fisheries in India and would provide the required baseline information for future planning and development initiatives at the Central and State Government levels. The Institute also made a significant achievement by bringing out for the first time a consolidated data base "*Marine fish landings in India 1985-2005 – estimates and trends*" which is a comprehensive source book for researchers, development workers and planners to understand the national, state-wise, region-wise, species-wise, year-wise and quarter-wise distribution of all the major groups of marine fishes in the country for the past 25 years. Another significant achievement was the publication of a manual on the "*Methodology for estimation of marine fish yield*". This publication also has a CD containing software developed by the Institute for this purpose.

Studies carried out by the Institute during the past year have indicated that the estimated marine fish landings of India during the year 2005 have shown a decrease of about 12% against the previous year, reporting 2.28 million t. The loss of fishing days and destruction of infrastructure including fishing crafts due to the tsunami also would have resulted in decline in fish yield. The disturbing fact is the decrease in catches of pelagic species like oil sardine, Indian mackerel, lesser sardines, croakers, ribbonfish, seerfish, penaeid prawns and cephalopods. There is urgent need for effective implementation of management interventions for sustainability of marine fisheries.

A major pelagic resource which is yet underexploited is the tunas. Only 23% of the potential yield of coastal tunas is currently harvested while in the case of oceanic tuna this is just 6%. There is need for diversification of fishing as well as extension of fishing to newer areas for harnessing this high value species. There is also need for simultaneous development of handling, processing and transportation facilities for value addition of tunas to high value products like *Sashmi*. India is yet to make use of the great potential and opportunities in this area.

The research efforts by the institute also focused on destructive fishing, discards at sea, by-catches and juvenile fishing. Mini trawls, '*thalluvalai*' and stake nets do destroy large quantities of juvenile fishes, shrimps and crabs. Our research paid special attention on some of these serious threats to resource sustainability and resilience in the maritime states. All these underscored the need for implementation of regulatory management measures. It is also pertinent to mention that the Director of the Institute served as the Chairman of the National Committee on Monsoonal Fishing Ban constituted by the Ministry of Agriculture and submitted the report to the Ministry.

The past experiences of the Institute in installation and monitoring of Fish Aggregating Devices (FADs) have led to new initiatives from maritime states like Tamil Nadu which approached the Institute for identification of sites,

technical support in designing and laying of FADs and monitoring of impact of FADs along the Tamil Nadu coast for increasing coastal fish production.

Another research initiative was to approach the concept of fisheries management based on ecosystem analysis. Under an MPEDA funded project, a co-management approach in lobster fisheries management has made measurable positive impact on the fishers from northwest and southeast coasts. The Institute also took part in national initiatives such as Hon'ble Agricultural Minister's interactions with fishers at Chennai, Ministry of Agriculture and MPEDA's, initiatives on fisheries sustainability at Cochin , and Tsunami rehabilitation projects initiated by governments of Kerala and Tamilnadu.

In the area of mariculture, the Institute undertook a new initiative during the current year by entering into the hitherto unexplored area of open sea cage farming. With massive funding from the Ministry of Agriculture, the Institute is working on installing research cum demonstration cages at Ratnagiri, Diu, Visakhapatnam and Mandapam. This new initiative will be a turning point in the marine fisheries development in the country and would lead to entrepreneurial and technological breakthroughs contributing to increase in production and newer market destinations.

Success was achieved in large scale hatchery production of the ornamental fishes, threespot damsel *Dascyllus trimaculatus* and the blue damsel *Pomacentrus caeruleus* through green water technique developed at the Mandapam Regional Centre. Clownfish was successfully bred in the hatchery at Cochin. The Institute also succeeded in developing successful rearing technique for the grouper *Epinephelus merra* at Mandapam Regional Centre.

Sea ranching of depleting marine resources like *Penaeus semisulcatus*, sea cucumbers and crabs was another area of activity during the past year. Success also was achieved for the first time in India in remote setting of clam *Paphia malabarica* and pearl oyster *Pinctada fucata*.

A significant achievement was the production of the first *in vitro* pearl with visible nacre coating from the mantle tissue of abalone. Continued efforts are being made for scaling up the larval production of the sand lobsters and for concluding the hatchery production of the lobster *Panulirus homarus*.

The Institute successfully demonstrated the feasibility and profitability of growing the seaweed *Kappaphycus* integrated with the bivalve green mussel in the Padanna area of the southwest coast. Unusually high production rates open up opportunities for large enterprises and for commercializing this activity. Because of the initiatives of the Institute entrepreneurial initiatives were made for establishment of pilot plants for production of carrageenan from the farmed seaweeds.

Several other areas in which the Institute could make progress are coastal monitoring of heavy metal pollution in fish, GIS based data base on potential mariculture sites, monitoring of the nesting activity of the endangered olive ridley in Orissa and risk assessment in sea food.

Through external funding, significant strides were made by collecting sighting data of marine mammals from 11 cruises on board FORV *Sagar Sampada* from the Arabian Sea and Bay of Bengal. The Institute also developed a cetacean DNA bank with 46 individual accessions from 7 species of marine mammals and deposited 20 mitochondrial DNA sequences in Gene Bank (NCBI).

Vulnerability of Indian fisheries to climate changes was another area in which Institute participated in a national project. Negative correlation of sea surface temperature with fish catch in the northeast coast and a positive correlation in the southeast and southwest coasts were identified. The project also yielded information on coral bleaching and variability in the abundance of fish eggs and larvae *vis a vis* temperature fluctuations.

The Marine Biodiversity Division conducted the resource survey to assess the live and dead coral of selected islands in the Gulf of Mannar Biosphere Reserve (GOMBR). 300 species of finfishes under 102 families were catalogued with meristic and morphometric characters as well as photographic records.

Biotechnological research yielded 4 strains of *Bacillus* capable of producing phytase. Eight bacterial pathogens from the marine ornamentals and 10 bacterial pathogens from pearl oyster larvae were isolated. The Institute also provided PCR-based diagnostic services for WSSV and Monodon Baculovirus to shrimp farmers.

Research on price behaviour of marine fish at landing site and economic performances of various fishing units were also worked out. The technological interventions proposed and field tested by the Institute would provide at a moderate adoption level of 25%, overall impact of additional revenue to the tune of Rs. 842 crores per annum.

It is gratifying to note that the Institute for the 3rd consecutive year received the Rajarshi Tandon Award for the best Institute in ICAR in implementing the official language programme.

In revenue generation, the Institute was able to achieve revenue of Rs. 105.5 lakhs as against the target of 100 lakhs. The ATIC also generated an income of Rs. 1.27 lakhs through sales and services.

The major publications of the Institute include 10 Special Publications, 35 papers in peer reviewed journals, 38 Technical articles, 16 Popular articles and 2 video CDs. 84 papers were presented in Seminar/Symposia.

This report presents the summary and results of the research carried out by CMFRI during 2005-06. All the staff of the Institute has strived towards achieving and fulfilling the mandate. That several foreign dignitaries visited the Institute and are in dialogue for sharing of expertise is indicative of excellence in work the Institute has been striving to achieve. On the invitation of FAO/NACA the Director of the Institute took part in the international workshop on future of mariculture in China during March. The NACA has agreed to include the Regional Centre of CMFRI at Mandapam as one of the training centres in mariculture for future training programmes in the Asian region.

I am grateful to all my colleagues for keeping the flag of CMFRI flying high. I am greatly indebted to Dr. Mangala Rai, Secretary DARE and Director General ICAR for his guidance and support extended to achieve our targets. I also place on record our sincere thanks to Dr. S. Ayyappan, Deputy Director General (Fy.), Dr. A.D. Diwan, Assistant Director General (M.Fy.) and Shri Anil Agarwal, Principal Scientist (M.Fy) for their continued support, guidance and help. I am confident that CMFRI will achieve greater heights in the years to come.

10 June, 2006
Cochin

MOHAN JOSEPH MODAYIL
Director

EXECUTIVE SUMMARY

Harnessing a widely distributed dynamic living natural resource needs great deal of management interventions based on real time scientific data. The major mandates of CMFRI are to monitor the marine fishery resources and to develop mariculture technologies. The institute implemented 31 inhouse projects, 21 sponsored projects and 9 consultancy projects during the period 2005-06. Ongoing marine fisheries research projects were reformulated and handled jointly by the scientists of CMFRI and CIFT for the appraisal of marine fisheries in maritime states and Lakshadweep. The salient research achievements of 10 divisions and other sections of CMFRI during 2005 are summarized below:

Capture fisheries

The estimated marine fish landings of India during the year 2005 has, provisionally, been estimated as 2.28 million t, registering about 12% decrease against the estimate of previous year. Decrease in the catches of oil sardine, Indian mackerel, lesser sardines, croakers, ribbonfish, seerfish, penaeid prawns and cephalopods have contributed to this decline. There was marginal increase in the catches of Bombay duck, carangids and non-penaeid prawns. Contributions from the west coast accounted for 67% of total landings. The pelagic finfishes constituted 55%, demersal 26%, crustaceans 15% and molluscs 4% of total landings. User-friendly software to simulate and forecast different management implications of fish and shellfish resources has been designed.

The All India Marine Fisheries Census 2005 entrusted to the Institute by DAHD&F, Ministry of Agriculture has generated valuable information on the fishing villages, households, fishermen population, craft & gear ownership pattern from 8 maritime states. This massive exercise would be feeder of vital ground level information to the planner. Projection based on 'Markov Chain Model' has indicated decline in the catches of oil sardine, penaeid prawns and cephalopods in the long run, but Indian mackerel catches are projected to increase by about 37% in 2020.

The production of 3.28 lakh t of oil sardine during 2005 showed a decrease by 5.6% over the last year. As in the previous year, large scale migration of juvenile and sub adult oil sardine into the backwaters during December was observed. The reduction in fecundity coupled with below normal rainfall prevailing consecutively for the last 4-5 years would tend to decrease stock of oil sardine in the next few years.

Estimates of population parameters in anchovies indicated that the major species were either under exploited or optimally exploited along the west coast. Exploitation of seerfish present an identically gloomy picture as in the previous year, calling for management options leading to discouraging small mesh sized 'podivalai' along SE coast and encouraging large mesh sized gill nets and hooks and lines in the exploitation of seerfish.

India is exploiting only 23% of the annual potential yield of coastal tunas and a mere 6% of the oceanic species. The skipjack, yellowfin and longtail tunas, which did not form a fishery along the mainland earlier, is now being landed on a regular basis, with the extension of fishing to the deeper grounds. Drift gillnetting in the offshore grounds, diversification of idling deep sea shrimp trawlers for monofilament tuna long lining and upgradation of pole and line tuna fishing operations in Lakshadweep waters are recommended to increase the tuna production from the Indian seas. The Indian mackerel showed signs of recovery from the progressive decrease in catches experienced since 2001.

The Bombay duck registered a marginal increase in production in 2005 compared to the previous year, contributing to 5.3% of total marine fish landings. There are perceptible signs of improvement in production in West Bengal. Ribbonfish fishery declined by about 13% compared to 2004 and there are perceptible indications of decrease in the stock, which entail reduction in fishing effort and increase in mesh size of the gear. Among the carangid species, *Megalaspis cordyla* was exposed to high fishing pressure by gill nets and trawl nets, *Decapterus russelli* by trawl, while *Selar crumunophthalmus* was underfished by both the gears.

Proportion of the elasmobranches in total demersal fish landings decreased by about 2% in 2005 compared to the previous year, contributed by sharks (57%), rays (36%) and skates (7%). While grouper catches remained at about the same level as those in the previous year, catfish production registered decline by 18.5%.

Threadfin breams are clearly over exploited. Though silverbellies showed increase by 10.4% over the last year, the long term trend in its production showed a declining pattern with reference to contribution to the total demersal catches. The all India croaker catches registered decrease to the tune of 5.5%. The all India pomfret landings were 44,190 t during 2005, which was constituted by silver pomfret (58%), black pomfret (34%) and Chinese pomfret (8%). The yield and standing stock biomass of Malabar sole (*Cynoglossus macrostomus*) indicated that the yield and standing stock biomass are almost equal, confirming heavy exploitation of the stocks. Nearly 50% of the trawl catch of 8 species of fish is constituted by juveniles along the Mangalore-Malpe sector.

Minitrawls, 'thalluvalai', *dol* nets and stake nets catch and destroy large quantities of juvenile fishes, shrimps and crabs, posing serious threat to the sustenance of shrimp fishery. Strict enforcement of mesh size regulation and ban on destructive fishing gears are recommended. Hooks and lines operated by fishermen on Fish Aggregating Devices (FADs) brought more high valued fishes compared to those operated outside FAD areas.

The low value bycatch/discards landed along Indian coasts were contributed mainly by juvenile sciaenids, silverbellies, threadfin breams, gobids, *Acetes* sp., squilla, crab, non penaeid prawns and molluscan shells. Proportion of the bycatch in total landings varied from 4.9% (Chennai) to 34.7% (Visakhapatnam). Appraisal studies of marine fisheries in Kerala, Karnataka and Goa, Gujarat, Maharashtra, Tamil Nadu and Pondicherry, Andhra Pradesh, Orissa, West Bengal and Lakshadweep have generated detailed information on the relative abundance of fishery resources, species composition, population dynamics of major species, craft and gear, socio economic status of fishermen and marketing dynamics. These valuable data would be useful for devising appropriate strategy for management of marine fisheries in these maritime states and union territories.

The Institute scientists have delineated the ecological groupings based on sharing ecological niches, size and feeding modes in the northwest coast (26 groups) and the Gulf of Mannar ecosystem (32 groups) and estimated ECOPATH parameters, such as diet composition, biomass estimates and aspect ratio. Under an MPEDA-funded project, a co-management approach in lobster fisheries management has made a positive impact on the fishers from northwest and southeast coasts by way of increased awareness on good fishing practices in lobster fishery.

Environmental & Biodiversity studies

A perusal of the environmental data on abiotic and biotic features of east and west coasts collected through regular monitoring programmes indicated drastic changes in the study areas. Study on the bioaccumulation and biomagnification of heavy metals in marine organisms from the coastal waters showed high biomagnification factor for Cd in the organisms from the higher trophic levels (fish and dolphin). Sediment samples collected from the industrialized areas contained high levels of toxic heavy metals.

There has been a noticeable increase in the number of olive ridley nesting along Orissa coast during 2005 compared to the previous year. GIS-based study identified 3 potential sites suitable for mariculture each in Maharashtra and South Karnataka, 18 sites from Kerala and 6 from Tamil Nadu.

Under a DOD-sponsored project on marine mammals, 118 sightings of cetaceans were made from 11 cruises on board FORV Sagar Sampada from the Arabian Sea and Bay of Bengal. Morphometric measurements and gut content analysis of 15 dolphins landed during November 2005-February 2006 at Gangolli, Malpe and Mangalore were carried out. Generally the metal and organochlorine pesticide concentrations in dolphins were higher from Chennai samples than those from Mangalore and Visakhapatnam. Almost all metals showed a trend of liver>kidney>muscle at all places of sampling except for Cadmium (kidney>liver>muscle). The Institute has developed a cetacean DNA bank with presently 46 individual accessions from bottlenose dolphin, spinner dolphin, common dolphin, Indo-Pacific humpbacked dolphin, Risso's dolphin, finless porpoise and sperm whale and also deposited 20 mitochondrial DNA sequences in GenBank (NCBI). Through this project the Institute has developed the capability to unambiguously identify any of these 7 endangered species even from a piece of skin without the need for seeing the whole animal or its photograph.

A study conducted on impact, adaptation and vulnerability of Indian fisheries to climate changes based mainly on secondary data for the past about 50 years indicated negative correlation of SST with fish catch in the northeast coast and positive correlation in the southeast and southwest coasts. The project has also brought forth information on coral bleaching and fish eggs and larval abundance vis a vis temperature changes.

Resource survey conducted to assess the live and dead coral cover of selected islands in the Gulf of Mannar Biosphere Reserve (GOMBR) showed highest diversity in Manauli and lowest in Anaipar Island. Three hundred species of finfishes under 102 families collected from selected landing centres along the east and west coasts were identified, photographed, quantified and documented the meristic and morphometric characters. Collection, preservation and documentation of common, uncommon and rare specimens for the Marine Biodiversity Museum were undertaken.

Mariculture

Hatchery production of threespot damsel *Dascyllus trimaculatus* and the blue damsel *Pomacentrus caeruleus* was standardized by employing the green water technique and by feeding with appropriate sized nauplii of copepods during the first two weeks and thereafter by freshly hatched *Artemia* nauplii. Clownfish was successfully bred in the hatchery at Cochin and the production technique was standardised. Better survival of the larvae was achieved by feeding with *Artemia* nauplii enriched with mixed micro algae.

About 4.3 million postlarvae of *Penaeus semisulcatus* and 53 million zoeae and 13449 baby crabs of *Portunus pelagicus* were searanched in the Gulf of Mannar during 2005. Captured seeds of *Thenus orientalis* in indoor system showed a biomass increase from 4 kg to 12 kg in 150 days. On growing *Panulirus homarus* phyllosoma VIII was attained in 42 days of hatching for the first time. Clam meat was found to augment chemoreception even during day time in sand lobster *Thenus orientalis* and the males attained early maturity. Remote setting of clam *Paphia malabarica* and pearl oyster *Pinctada fucata* was achieved for the first time in India.

Technology to produce multiple mabe pearls from individual pearl oysters was developed. The first in vitro pearl with visible nacre coating was produced from the mantle tissue of abalone. The mussel declumper (Prototype II) developed by the Institute offers relief to fisherwomen from physical exertion during harvesting.

Farming of seaweed *Kappaphycus* sp. by the Institute at Mandapam, Cochin and Calicut yielded encouraging results during 2005. *Penaeus monodon* stocked in a pond containing *Gracilaria verrucosa*, did not contract viral disease whereas in the control pond without seaweed the shrimp was subjected to viral attack. Method for extraction of optimum quantity and high quality carragennan from *Kappaphycus* was standardised.

Integrated farming of seaweed with green mussel also produced encouraging results. During the reporting year Mariculture Division of the Institute organized several frontline demonstration and training programmes on farming of mussel, edible oyster and seaweed in association with the State Fisheries Departments and other aquaculture development agencies.

Physiology, nutrition and pathology

Four strains of *Bacillus* capable of producing phytase were isolated from the mangrove swamp. Acid phosphatase, which negates the antinutritional effects of feed supplements, was purified from *Bacillus licheniformis*. Minimum amount of fishmeal required in the formulated feeds for *Penaeus semisulcatus* was found to be 150 g/kg.

Chemo-attractant soyalecithin at 3% level in the diet resulted in 74.4% growth and low FCR of 1.44 in *Panulirus homarus*. Eight bacterial pathogens from the marine ornamental fishes and 10 from pearl oyster larvae were isolated. Molecular identification of *Vibrio parahaemolyticus* using species specific primers was achieved. Isolates of *Aeromonas hydrophila* collected from mariculture ponds exhibited considerable amount of genetic diversity. PCR-based diagnostic services for WSSV and Monodon Baculovirus were provided to the shrimp farmers.

Protective immunity was developed in grouper *Epinephelus malabaricus* through vaccination with whole cell killed preparation from the virulent strain of *V. anguillarum*. Biomolecule HB2b fraction of Hexane Benzene (60:40%) in PBS (pH 7.0) from *Ulva fasciata* showed highest antibacterial activity against *V. alginolyticus.* The methanol extract of *Hypnea musciformis* inhibited pathogenicity of *Pseudomonas aeruginosa* and *V. alginolyticus*.

Genetic analysis of Bombay duck (*Harpadon nehereus*) sampled from the northwest and northeast coasts clearly showed higher genetic variability in the stock from West Bengal compared to that from Mumbai. *Penaeus monodon*, affected by 'loose shell syndrome' showed etiological characteristics resembling Necrotizing Hepatopacreatitis (NHP) such as lethargy, reduced growth, increased food conversion ratios, anorexia and soft shells.

Socio-economics and Extension

Price behaviour evaluation of marine landings has indicated that marketing margin of high quality fishes and exportable varieties were comparatively less and stable in the internal marketing system. By and large there was an increase in the average prices of all varieties of fish except during post-tsunami period. Economic performance of the fishing units was worked out. Functional analysis of the key indicators of the single and multi day trawlers predicts increasing phase of multi day fishing in the coming years.

The ATIC had generated an income of Rs.1.27 lakhs through sale of technological products, publications, diagnostic services and laboratory tests.

Publications, New Projects & Recognitions

The Institute staff had published a total of 35 research papers in peer-reviewed journals, 38 technical articles and presented 84 papers in seminars/symposia. The Institute has won the Rajarshi Tandon Award for best work in Official Language Implementation Programme for the year 2005. Scientists of the Institute were honoured with awards for best research paper and poster presentation in National Seminars and Symposia. The Institute participated in the All India Aqua show – 2006 organized by Department of Fisheries, Government of Kerala at Cochin and bagged First Prize for the best Marine Aquarium and won the best marine stall price in the Aqua show held at Thiruvananthapuram during 9th-18th September, 2005. Six new projects on issues of cage culture, tuna resources, deep sea resources, fish seed production and aquaculture health management were approved under Ministry of Agriculture, Dairying and Fisheries, DBT, DOD and ICAR network.

Consultancy Services

Consultancy services were provided to several agencies such as KIOCL, GMREL, Karnataka State Biodiversity Board, Tamilnadu Fisheries Department and M/s. Chennai Water Desalination Ltd. Nine ongoing consultancy programmes generated Rs.1.16 crores during 2005-06.

Training & Education

Under the education programme, 10 regular students and SRFs of funded projects were awarded Ph.D degree during 2005. KVK conducted 97 training programmes and 100 courses during the reporting year.

Revenue generation

Against a target of Rs. 100 lakhs, the Institute generated revenue of Rs.105.5 lakhs.

INTRODUCTION

The Mandate

- *To monitor and assess the exploited and under-exploited marine fisheries resources of the Exclusive Economic Zone (EEZ); to understand the fluctuations in their abundance in relation to changes in the environment and human interventions.*
- *To develop suitable mariculture technologies for finfish, shellfish and other culturable organisms in coastal and open seas to supplement capture fisheries production.*
- *To prepare marine biodiversity inventory, carry out research on sensitive marine ecosystem for their conservation and restoration and to undertake research on molecular level interventions on selected marine organisms to draw better benefits.*
- *To act as a repository of information on marine fishery resources with a systematic data base of policy interventions and to carry out research on socio-economic status of fishers.*
- *To conduct transfer of technology through first line demonstration and HRD for marine capture fisheries, mariculture, marine biodiversity and biotechnology.*
- *To provide consultancy services and generate funds.*

The marine fisheries sector plays a major role in supplying cheap and nutritious food to the increasing population and is an instrument of livelihood for a large section of rural population of the country. With a long coastline of 8118 km and an Exclusive Economic Zone (EEZ) of 2.02 million sq.km, India has an estimated annual marine fishery resource potential of 3.9 million t. The vast areas along the coastline offer ideal sites for seafarming and coastal mariculture. The fisheries sector has been a major source of foreign exchange earnings through export, contributing to Rs. 66470 million during 2004-05. Declining yields from conventional coastal fishing grounds, increasing conflicts between different resource users, degradation of the ecosystem and ever-increasing demand for seafood for domestic consumption and export are challenging problems confronting Indian marine fisheries sector. This highlights the need for scientific management of our fishery resources through appropriate region/area-wise regulatory measures and adherence to the code of conduct, in order to ensure their long term sustainability and availability to the future generation. The potential for enhancement of fish production through large scale ecofriendly coastal mariculture is enormous. The proper management of fishery resources therefore requires a multidisciplinary approach calling on greater and more effective R & D efforts and CMFRI has been addressing these issues by undertaking need-based and problem oriented research.

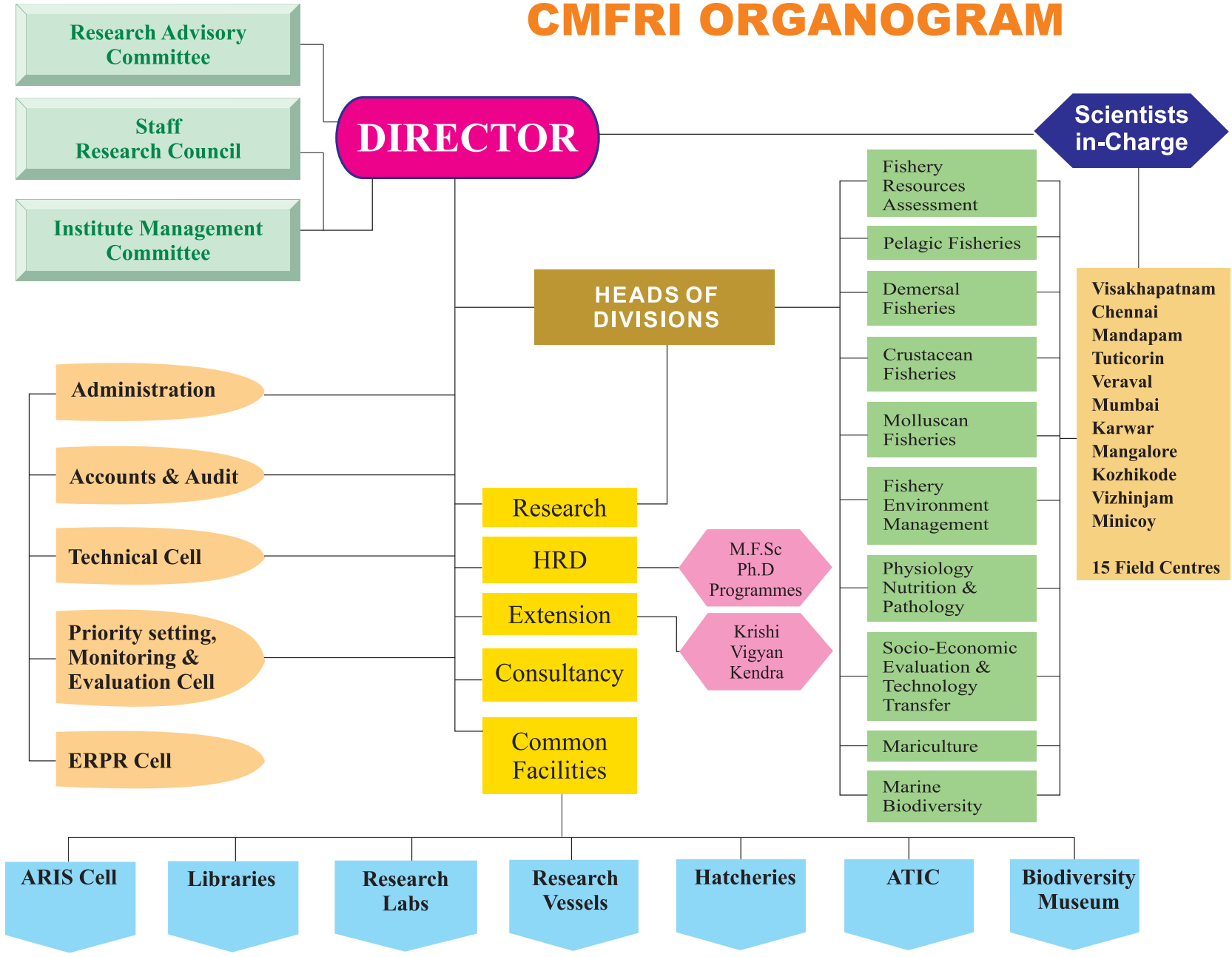
The Central Marine Fisheries Research Institute (established in 1947) is the nodal agency in India, responsible for research support in marine fisheries development. Over the period of 58 years since its inception, the CMFRI grew significantly in its size and stature by building up a fairly adequate research infrastructure and recruiting suitably qualified R & D staff. The Institute's multidisciplinary approach to research in marine capture and culture fisheries has won the recognition as a premier Institute comparable to any well-established marine fisheries laboratory in the world.

To accomplish its mandate, the Institute monitors the marine fish landings from all along the country's coast, conducts researches on characteristics of exploited marine fish stocks and impact of trawling on marine ecosystems, develops hatchery production technology and seafarming techniques, undertakes research in environmental characteristics of inshore sea, studies on marine biodiversity and conducts postgraduate education programmes leading to M.F.Sc and Ph.D. degree. Studies are also conducted on economics of fishery enterprises, socio-economic conditions of fisherfolk and co-management of fishery resources through participatory approach.

The organisational set-up

To effectively carry out these tasks, the Institute has established Regional Centres at Mandapam Camp, Veraval and Visakhapatnam, Research

CMFRI ORGANOGRAM



Staff Strength as on 31.03.2006 (2005-06) including KVK, Narakkal

Category	Sanctioned	Filled	Vacant
RMP	1	1	0
Scientific	189	121	68
Technical	330	323	7
Administrative	153	149	4
Supporting	263	237	26
Auxiliary	6	6	0
Total	942	837	105

Centres at Minicoy, Mumbai, Karwar, Mangalore, Kozhikode, Vizhinjam, Tuticorin and Chennai and 15 Field Centres all along the coast. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory, hatchery and farm facilities for carrying out research programmes and has been upgrading the same to meet the changing needs and additional requirements. The sanctioned staff strength of the Institute is: Scientific 189, Technical 330, Administrative 153, Auxiliary 6 and Supporting 263.

The multidisciplinary researches in capture and culture fisheries are conducted under ten Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment Management, Physiology, Nutrition and Pathology, Socio-economic Evaluation and Technology Transfer, Mariculture and Marine Biodiversity. Interdivisional and interinstitutional programmes are carried out for greater utilisation of expertise and facilities. Besides, the Institute also takes up short-term research projects on important and priority areas through *ad hoc* research projects funded by outside agencies in the country and abroad, and offers consultancy services to the clients from Government organisations as well as private industry.

Under the Postgraduate Programme in mariculture, the Institute organises M.F.Sc. and Ph.D programmes of the Central Institute of Fisheries Education, Mumbai, a Deemed University under the ICAR. The teaching programme is carried out by the scientists of the Institute.

The *Krishi Vigyan Kendra* imparts training in mariculture, agriculture, animal husbandry and other related subjects to fish farmers, agricultural farmers and farm women.

The Library and Documentation Section provides reference facilities to research staff and students of the Institute as well as to visiting scientists both within and outside the country. The implementation of Hindi as Official Language is carried out by the Official Language Implementation Cell (OLIC).

The results of research carried out in the institute are published in various journals. Besides, the Institute brings out Bulletins, Special Publications, Quarterly Newsletter and the Marine Fisheries Information Service and publishes the Indian Journal of Fisheries.

Budget 2005 – 2006

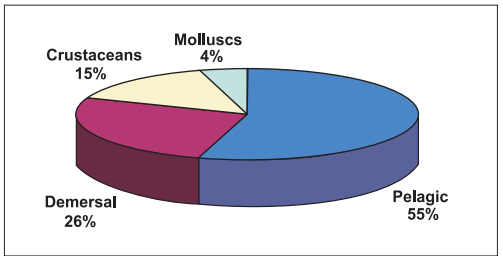
The Budget and Expenditure under Non Plan and Plan for the financial year 2005-06 in respect of this Institute is as detailed below:-

(Rs. in lakhs)

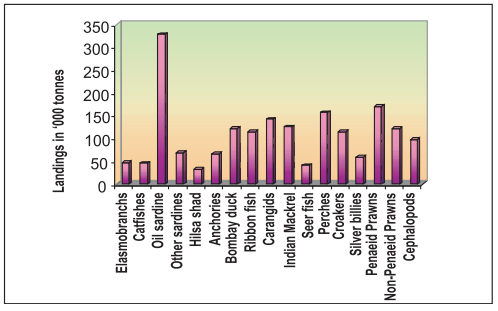
Sl. No	Sub Head	RE 2005-06	Expenditure for 2005-06
NON PLAN			
1	Estt. charges	1580.00	1580.00
2	O.T.A.	1.20	1.20
3	T.A	19.40	19.40
4	Other Charges	437.00	437.00
5	Works		
	a) Office Building	116.00	116.00
	b) Residential Building	41.00	41.00
	c) Minor Works	7.40	7.40
6	Other Items	1.00	1.00
	Total	**2203.00**	**2203.00**
PLAN			
1	Estt. charges	-	-
2	T.A.	21.00	21.00
3	Other Charges		
	a) Contingency	230.25	230.25
	b) Equipment	75.00	75.00
	c) Library	40.00	40.00
	d) Information Technology	15.00	15.00
4	Works		
	1. Works as per EFC		
	a) Special Repairs	118.50	118.50
	b) Major works		
	2. One time Catch-up-grant		
5.	a) Other items	0	0
	b) HRD	0.25	0.25
6.	N.E.H.	NIL	NIL
	TOTAL	**500.00**	**500.00**

Marine Capture Fisheries

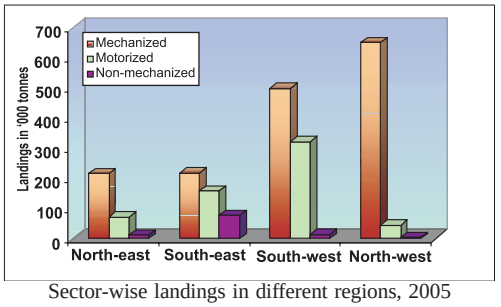
PROJECT CODE	**FRA/ASSESS/01**
PROJECT TITLE	**Assessment of exploited marine fishery resources**
SCIENTISTS	**K. Balan,** M. Srinath, T.V. Sathianandan, J.Jayasankar, Wilson T. Mathew, Somy Kuriakose and Mini. K.G
CENTRES	Cochin and Chennai



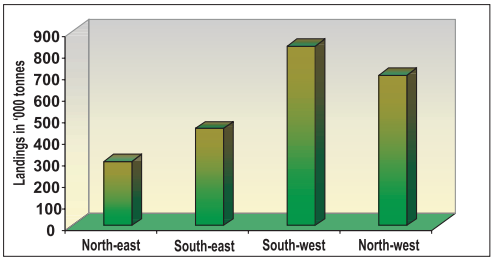
Resource components of marine fish landings in India during 2005



Landings of major fishery resources during 2005



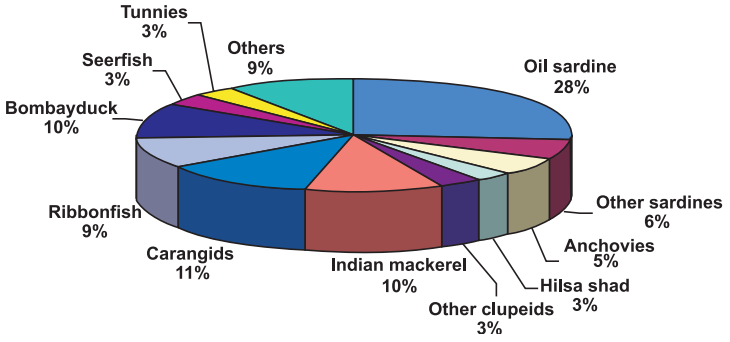
Sector-wise landings in different regions, 2005



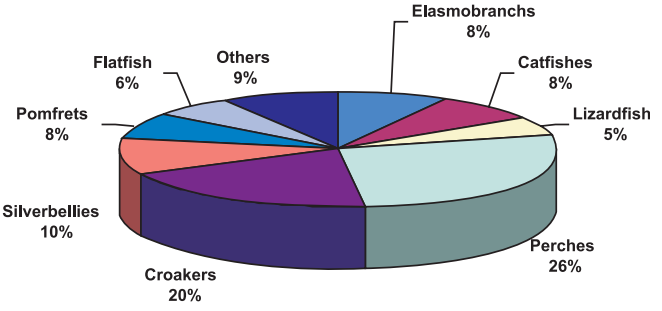
Region-wise landings in India, 2005

This project aims to estimate the marine fish landings and fishing efforts in different regions of the country with resource-wise and gear-wise break up of the exploited resources. It also aims to maintain the database on marine fish landings in India existing at the Institute. A **multistage stratified random sampling design** was employed to collect and estimate the landings of the exploited marine fishery resources. It involved planning, execution and co-ordination of field work, processing of data and updating database, developing suitable formats for storage and retrieval.

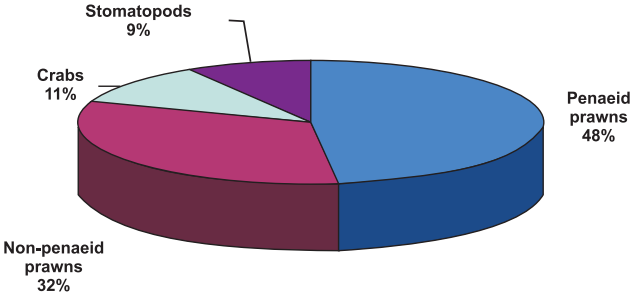
- Among the commercially important groups, fishery of oil sardine, lesser sardines, croakers, seerfishes, penaeid prawns and cephalopods recorded decrease in the catches and there was a slight increase in Bombayduck catches.
- The fishery of ribbonfishes, recorded a decrease and non-penaeid prawns showed a slight increase in the catches when compared to that of the previous year.
- The fishery of perches and Indian mackerel landings had decreased.
- The region-wise estimated fish production showed that the north-east region, comprising West Bengal and Orissa coasts contributed 13.1% to the total production. South-east region consisting of Andhra Pradesh, Tamilnadu and Pondicherry coasts contributed 19.8%. On the west coast, south-west region comprising Kerala, Karnataka and Goa coasts recorded 36.5% of the total, whereas, the north-west region comprising Maharashtra and Gujarat coasts contributed a maximum of 30.6 %.
- Oil sardine landings recorded 3.29 lakh tonnes during the year 2005 registering 14% decline over the previous year.
- The Bombayduck fishery showed a marginal increase of about 8,500 tonnes with an estimate of 1.21 lakh tonnes during 2005.
- The fishery of croakers during the 2005 was 1.15 lakh tonnes with a decrease of 4,800 tonnes over the previous year.
- A marginal decrease of 1,600 tonnes was observed in the landings of penaeid prawns, with the estimate of 1.7 lakh tonnes during 2005.
- Cephalopod fishery recorded a decline of about 16000 tonnes during the year 2005 with an estimate of 97 thousand tonnes.
- The landing of perches recorded a decrease of 37,000 tonnes (19%), with an estimate of 1.57 lakh tonnes.



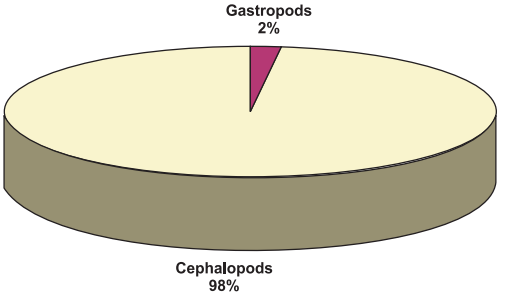
Components of pelagic finfish landings, 2005



Components of demersal finfish landings, 2005



Components of crustacean landings, 2005



Components of molluscan landings, 2005

Estimated Marine fish landings (t) during 2004 and 2005

Pelagic finfish			Demersal finfish		
Name of fish	**2004**	**2005**	**Name of fish**	**2004**	**2005**
CLUPEOIDS			ELASMOBRANCHS		
Wolf herring	14330	14496	Sharks	35215	26860
Oil sardine	381448	328636	Skates	3378	3248
Other sardines	87065	69127	Rays	19990	16906
Hilsa shad	62925	32004	EELS	7998	8670
Other shads	4288	5810	CATFISHES	52137	45335
Coilia sp.	33455	33441	LIZARD FISHES	35911	30552
Setipinna sp.	5055	5090	PERCHES		
Stolephorus spp.	47773	27860	Rock cods	18213	18538
Thryssa spp.	25249	40987	Snappers	6974	5732
Other clupeids	36569	40032	Pig face breams	11264	9569
BOMBAYDUCK	112954	121442	Threadfin breams	118899	88347
HALF BEAKS&FULL BEAKS	3371	2553	Other perches	37903	34482
FLYING FISHES	2566	917	GOATFISHES	16295	17052
RIBBON FISHES	131002	113848	THREADFINS	8827	9115
CARANGIDS			CROAKERS	120186	115315
Horse Mackerel	25718	29862	SILVERBELLIES	51417	58312
Scads	41693	54224	WHITEFISH	3280	3243
Leather-jackets	11520	9689	POMFRETS		
Other carangids	54419	48334	Black pomfret	17494	14787
MACKERELS			Silver pomfret	19605	25405
Indian mackerel	141774	125172	Chinese pomfret	2024	3998
Other mackerels	0	0	FLAT FISHES		
SEER FISHES			Halibut	1047	1106
S. commerson	32804	28157	Flounders	122	119
S. guttatus	14487	12203	Soles	35033	33768
S. lineolatus	3	0	MISCELLANEOUS	32447	16027
Acanthocybium spp.	195	198			
TUNNIES			**Total**	**655659**	**586486**
E. affinis	17555	22189	**Shellfish**		
Auxis. spp	6632	5804			
K. pelamis	2123	1614	CRUSTACEANS		
T. tonggol	5782	4515	Penaeid prawns	171641	170003
Other tunnies	5919	5826	Non-penaeid prawns	116231	121178
BILL FISHES	6650	2968	Lobsters	1371	1117
BARRACUDAS	13627	15857	Crabs	40900	37117
MULLETS	6086	5969	Stomatopods	32071	21189
UNICORN COD	808	717	MOLLUSCS		
MISCELLANEOUS	69549	33983	Cephalopods	112742	97024
			Miscellaneous	2096	1488
Total	**1405394**	**1243524**			
			Total	**477052**	**449116**
			Grand total	**2538105**	**2279126**

- The landings of mackerel recorded a decrease of 17,000 tonnes with an estimate of 1.25 lakh tonnes.
- The estimate of ribbonfishes was 1.14 lakh tonnes which recorded a decline of 17,000 tonnes.
- The landings of carangids was 1.42 lakh tonnes with an increase of about 9,000 tonnes.
- The non-penaeid prawn fishery also witnessed a marginal increase of about 5,000 tonnes with an estimate of 1.21 lakh tonnes.
- The database on landings of exploited marine fishery resources maintained by the Institute has been updated with current estimates of 2005.

Salient findings

- *The estimated marine fish landings of India during the year 2005 has provisionally been estimated as 2.28 million tonnes, which recorded a decrease of about 2.59 lakh tonnes against the estimate of the previous year.*
- *The pelagic finfishes constituted 55%, demersal fishes 26%, crustaceans 15% and molluscs 4% of the total landings.*
- *The sector-wise contribution of fish landings during the year 2005 were mechanized landings 69%, motorized landings 26% and the artisanal landings 5% .*

PROJECT CODE **FRA/ASSESS/02**

PROJECT TITLE **Stock assessment techniques in marine fish and shellfish resources and management**

SCIENTISTS **T.V. Sathianandan,** M. Srinath, J. Jayasankar, Somy Kuriakose and Wilson T. Mathew

CENTRES Chennai and Cochin

Under this project, which underwent a major technical revamp in the last SRC, a final workable model which best describes the changing biomass scenario has been zeroed in. Through the model, which belongs to the surplus production genre in modeling parlance, algorithm to simulate and forecast yield of various resources off the Kerala coast has been chiseled out. The paradigm, with the time tested parameters like initial biomass, carrying capacity, intrinsic rate of growth and catcheability coefficient as the pivots in framing the future game scenario has been coded to take the shape of a workable module in C++. Different scenarios, which could be perceived in the times to come, have been planned to be incorporated as input after getting them translated into effort units. The most formidable hurdle in this process of simulating scenarios, estimating optimal parametric values, has been tackled by the utilization of Genetic Algorithm (GA), one of the most versatile of non-linear optimization tools available. The intrinsically non-linear setup has been so devised to perform that the parametric estimation and the ensuing yield forecast take place in tandem with due degree of repeatability. For example, the MTN scenario, which was based on the observed information from 1986 to 2004, has a perceptible dip in yield after late 1990, whereas the estimated biomass picture shows mild signs of recovery towards the end. Upon combining the simulated scenario of major gears off Kerala coast, the biomass slotting will become more responsive to ground realities and hence will yield better glimpse of the various eventualities of prospective managerial scenarios. An user-friendly software to simulate and forecast different management implications has been designed.

Annual landings of 26 selected marine fish species/groups in Kerala during 1960-2004 were analysed through principal component analysis, Fisher Information and average standard deviates to examine regime shifts. First three principal components accounted for 89.97% of the variations in the multivariate time series and from the factor loadings it was observed that variations in these components are mainly due to that of oil sardine, mackerel, perches, carangids, anchovies and penaeid prawns. Possible regime shift periods identified were 1993-96 and 1994-99. Further examination through average standard deviates showed significant regime shift during 1994-99 compared to 1973-93 period but there were values spread on both sides of zero showing some limitation in the inference.

PROJECT CODE	**FRAD/IDP/01**
PROJECT TITLE	**Appraisal of marine fisheries of West Bengal**
SCIENTISTS	**M. Srinath,** K.Balan, J. Jayasankar and Somy Kuriakose
CENTRE	Operated from Cochin

This project aims at assessing the marine fisheries of West Bengal by means of sustained periodic planned collection of catch and effort data and development of macro paradigms explaining the trend and sustainability. The potential yields of major resources of West bengal are estimated taking into consideration, the maximum yield and the average long term yield. The highest landings observed in a mature fishery can be taken as an estimate of the long term potential yield (LPTY). Similarly the peaks in the smoothed production may be taken as estimates of average long term yields (ALTY) of the resource assemblage in a given area. Here time series of landings were smoothed by taking 5 point running average. The sequence of peaks reached by each species or species group can be used to identify the different phases of development of the fishery.Smoothing the original series has the effect of reducing, but not completely eliminating the potential impact of interannual environmental changes of natural populations. The historical maximum values and the peaks of the smoothed series for major resources of West Bengal are presented in table.

Resources	**LPTY**	**Year**	**ALTY**
Sharks	3150	1997	1760
Catfishes	9154	2002	6963
Wolf herring	2765	2004	1552
Hilsa shad	58191	2004	24978
Coilia sp.	6051	2003	4415
Setipinna sp.	5281	2002	3392
Other clupeids	6031	2004	4431
Bombayduck	42101	2003	26654
Croakers	16306	2003	12551
Ribbonfishes	7148	2003	5672
Black pomfret	2463	2004	1384
Silver pomfret	5030	2002	3506
Penaeid prawns	12705	2003	8534
Non-penaeid prawns	20792	2003	14819
TOTAL	**193898**	**2004**	**142974**

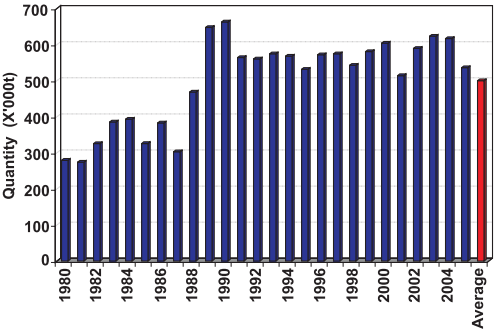
PROJECT CODE	**PEL/IDP/01**
PROJECT TITLE	**Appraisal of marine fisheries of Kerala**
SCIENTISTS	**N. G. K. Pillai,** A. A. Jayaprakash, K. K. Appukuttan, T. S. Velayudhan, K. S. Mohamed, Mary K Manisseri, E. V. Radhakrishnan, G. Nandakumar, E. Vivekanandan, S. Sivakami, Rekha Devi Chakraborthy, N. G. Menon, C. Ramachandran, Somy Kuriakose, P.T. Sarada, P. Laxmilatha, P.N.R. Nair, M. Sivadas, P.P. Manoj Kumar, K.K. Philipose, Grace Mathew, M.K. Anil and Leela Edwin (CIFT)
CENTRES	Cochin, Vizhinjam and Calicut

Marine fish landings in Kerala during January-December 2005

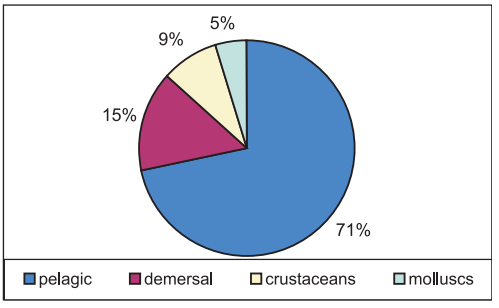
- Developed a macro level simulation model based on surplus production model. Effect of closure of fishery is simulated using a biomass dynamic model incorporating process and observation uncertainty. The programme SIMSRI1 was developed in VB.
- Marine fish production in Kerala during 1980-2005 fluctuated from 2.74 lakh t in 1981 to 6.62 lakh t in 1990 with an average of 5.14 lakh t. The annual marine fish landings from 1980-2005 shows two distinct growth phases. The first phase is from 1980- 87 with an annual average landings of 3.34 lakh t and the second from 1988 -2005 with an annual average of 5.74 lakh t.
- The marine fish landings of Kerala during January-December 2005 has been estimated at 5,36,215 t which recorded a decrease of 13 % (80,624 t) against the corresponding period of 2004. The state contributes 24% to the total marine fish production of the country.
- The pelagic fishes constituted 71 %, demersal 15 %, crustaceans 9% and molluscs 5% of the total landings. The mechanized sector contributed 54 %, motorized 45 % and the rest 1% is artisanal. The highest landing 31% was recorded during the IV quarter (Oct- Dec) followed by III quarter (27%), II quarter (23%) and I quarter (19%).
- The estimate of district wise production showed that Kozhikode district contributed 21% followed by Kollam (16%), Malappuram (13%), Alappuzha (12%), Ernakulam and Thrissur (11% each) and the rest by other districts.
- Among the important groups, carangids, tunas, catfish, flatfishes and penaeid prawns recorded an increase in the landings compared to 2004.

Pelagic finfish resources

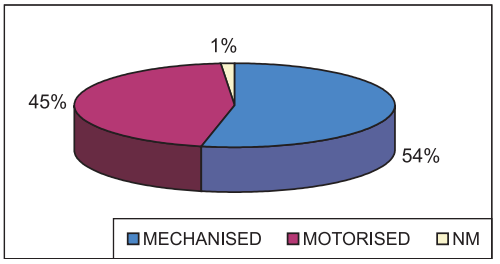
- Oil sardine landing was 2,18,796 t (forming 41% of the total production) during the year registering a decrease of 3 % over the last year (2,24,706 t). The decline is related to the decadal trends in stock abundance. However, the resource was exploited at MSY level. Major gear was ring seine with small mesh (8-20 mm) and the size group of 92 - 172 mm formed the bulk of the landings.
- The highest oil sardine production was from Alappuzha District (47,390 t) followed by Kozhikode (44,013 t) and Malappuram (35,570 t).
- Juveniles (<100mm) and pre-adults (100-140 mm) constituted 16,307 t in Alappuzha (34% of total catch at this centre). Half of this quantity



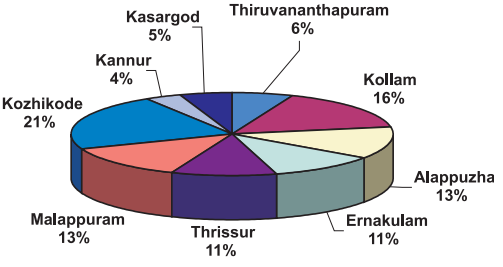
Marine fish landings in Kerala during 1980-2005



Components of marine fish landings in Kerala during 2005



Sectorwise marine fish landings in Kerala during 2005



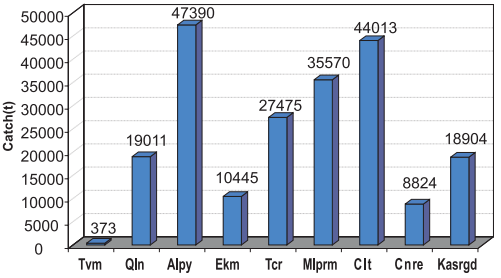
District-wise marine fish landings in Kerala during 2005

Group-wise marine fish landings of Kerala during the year 2004 and 2005

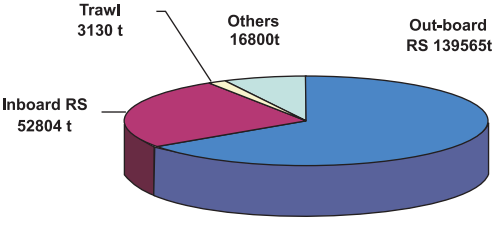
Fish groups	2004	2005	%(2005)	% decrease/ increase
Pelagic finfishes				
Oil sardine	224706	218796	41	-3
Other sardines	17731	7251	1.3	-59
Whitebaits	28292	10717	2	-62
Ribbonfishes	12863	11755	2	-9
Carangids	37529	46590	9	24
Indian mackerel	54011	50498	9	-7
Seer fishes	8784	7436	1.4	-15
Tunas	14499	19571	4	35
Other clupeids	9081	6611	1	-27
Barracudas	4782	3810	0.7	-20
Other pelagics	1374	1255	0.2	-9
Total pelagics	**413652**	**384290**	**72**	**-7**
Demersal finfishes				
Sharks	2533	1446	0.3	-43
Catfishes	172	268	0.05	56
Lizard fishes	13373	8542	1.6	-36
Threadfin breams	46466	26949	5	-42
Rock cod	5785	3800	0.7	-34
Sciaenids	5759	5184	1	-10
Other perches	10654	7300	1.4	- 31
Pomfrets	1248	234	0.04	-81
Flatfishes	16274	18409	3	13
Other demersals	6245	7993	1.5	28
Total demersals	**108509**	**80125**	**15**	**-26**
Shellfishes				
Penaeid prawns	30577	31516	6	3
Non-penaeid prawns	8624	7236	1.3	-16
Lobsters	264	45	0.008	-83
Crabs	5506	5428	1	-1
Stomatopods	5617	1433	0.3	-74
Gastropods	1062	739	0.2	-30
Cephalopods	41684	24764	5	-41
Total shellfishes	**93334**	**71161**	**13**	**-24**
Miscellaneous	1344	639	0.1	-52
Grand Total	**616839**	**536215**		**-13**

was sundried to get 2,040 t of dryfish. The dry fish trade even at a conservative minimum of Rs. 7 worked out to Rs.1.4 crores. The commodity was transported to Tamil Nadu and Andhra Pradesh. At Ambalapuzha a wet fish meal plant has been set up to handle the glut situation and to meet the demand from poultry feed manufacturers. Dryfish trade of the same magnitude was flourishing at Kozhikode also.

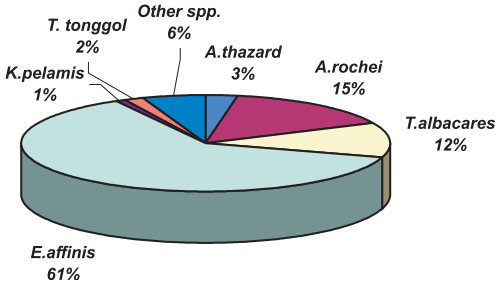
- A decrease of 11,856 t was observed in the landings of lesser sardines, the estimate being 7291 t during 2005. *Sardinella gibbosa* dominated the catch
- Total catch of *Stolephorus* spp. was 10,717 t in Kerala contributing 4.8% to total marine fish landings. The production was less by 19,619 t compared to last year.
- Distant water fishing by trawlers has reduced the fishing intensity in the 50 m depth zone leaving the resources for exploitation mostly to the ring seines.
- There was a reduction in the catch of *Stolephorus* spp. starting from southern side to the northern regions, in Kerala. These fishes in general, and *S.buccaneeri* and *Encrasicholina devisi* in particular have very good consumer demand in the southern districts. This is reflected in the under-exploitation of the resources in the northern parts in Kerala.
- The white bait fishery was supported by *E. devisi* (38%), *Stolephorus commersonii* (20%), *S.macrops* (18%), *S. buccaneeri* (10%) and *S.waitei* (9%).
- Indian mackerel landings showed a decrease of 7% (3,500 t) compared to 2004 (54,011 t). The fishery was conspicuous by the absence of large-scale juvenile recruitment during most of the period.
- At Malabar region, the population parameters estimated based on ring seine landings were $L\alpha = 290$ mm, K = 1.6, M = 2.82, l_m =175mm. The total biomass was 47,375 t. The yield was 31,368 t with the recruitment of 216.7 million young ones. The spawning stock biomass was 33,622 t, which formed 71% of the standing stock. The results of the Thompson and Bell analysis indicated that the yield was continuously increasing suggesting that the present effort is not affecting the stock.
- Total ribbonfish catch in Kerala was 11,800 t compared to 15,190 t in the last year. The resource contributed to 2% of the total marine fish landings in the state and was entirely constituted by *Trichiurus lepturus*. Being migratory, the availability of this species for exploitation is highly seasonal along the Kerala coast.
- The resource was exploited by the multi-day and single-day trawlers mainly at four maritime districts: Kollam (3,078t), Ernakulam (2,099t), Kozhikode (3,460t) and Kannur (2,439t).
- The estimated size at first maturity (at 50% level) at Kozhikode was 46cm. The sex-ratio (M:F) in *T. lepturus* was 1:1.6 among adults and 1:3.5 among pre-adults. Spent fishes were noticed from August to December with peak spawning from October onwards. The fecundity, ranged from 6,399 to 48,555 ova with an average fecundity of 18,816.



District-wise oil sardine landings (t) in Kerala - 2005



Gear-wise landings (t) of oil sardine - Kerala



Species composition of tuna, Kerala 2005

- The present ribbonfish yield is 11,800t, against the MSY of 14,820t.The estimated spawning stock biomass is 6,430t, standing stock biomass 10,160t and recruitment (Nos.) 126,366.
- The total catch of carangids was 46,590t compared to 44,172 t in 2004 and 36,097t in 2003. The highest production was from Kozhikode (21,561t) followed by Kollam (1,3791t), Thiruvananthapuram (8,725t) and Cochin (7,580). The ringseines (42%), trawl (31%), the boat-seines & shore-seines (14%), gillnets (8%) and the rest by hooks & lines contributed to the production.
- The scads dominated the carangid landings at Kozhikode, Cochin, Kollam and Thiruvananthapuram. Their contribution was highest at Kozhikode followed by Thiruvananthapuram and Kollam. Other carangids comprising *Selar crumenophthalmus* and a variety of large growing species dominated the catch at Kollam and at Kozhikode.
- Tunas showed an increase of 35% (19,571 t) compared to 2004 (14,500 t). *Euthynnus affinis* dominated the catch followed by *Auxis thazard, Katsuwonus pelamis* and *Thunnus albacares*. Average annual standing stock of *E. affinis* is estimated at 4,953 t against the yield of 12,203 t (2005). Multi-day drift gill net fishing in the distant waters is responsible for the increase in tuna landings.
- The catch estimate of seerfishes was 7,436 t, which recorded a decline of 1,348 t (15%). The spawning stock biomass, standing stock and total yield for *S.commerson* along the Kerala waters have been worked out as 228t, 2,983t and 7,250, t respectively.
- Among the major pelagics exploited by different gears, most of the species had mean size above the minimum size at maturity except *S.longiceps and S.commerson* indicating heavy exploitation of juveniles and sub- adults of the oil sardine and King seer.

Demersal finfish resources

- Among the demersal finfish resources, threadfin breams were the dominant group forming 7% of the total landings followed by soles 3%, lizardfishes and other perches (2% each).
- The estimated landings of elasmobranchs in Kerala amounted to 2,959 t contributed by rays 43%, sharks 49% and skates 8%. Growth parameters (Lα and K) estimated for C*archarhinus limbatus* were 302 cm and 0.44/ year respectively. Z = 2.73/year, M = 2.19/year and F= 0.54/year. Recruitment takes place almost throughout the year with peak in April-May. E= 0.80 which is higher than E_{max} = 0.75, indicating that the *C.limbatus* along the Malabar coast is marginally over-exploited.
- Flatfish catch was estimated as 18,409 t registering an increase of 12 %. Three species of flat fishes dominated the catch. *Cynoglossus macrostomus* was the dominant species followed by *C.dubius* and *C.arel*. Multi-day trawling contributed 86% to the total catch.
- Growth parameters of *C.macrostomus* (Lα and K) estimated were183 mm and 0.92/ year respectively Z= 4.80/year, M= 0.92/year, F= 3.88/ year and Lc = 115.5 mm. Recruitment takes place almost throughout the year with peak from March to August. E= 0.81 which is less than E_{max} (0.84).

Mean-size and length at maturity (L_m) of major pelagics

Species	Gear	Mean-Size	L_m
Rastrelliger kanagurta	Trawl	19.5	19.0
	Ring seine	17.5	17.5
Euthynnus affinis	Drift gill net	46.7	43.0
Auxis thazard	"	36.2	30.0
Katsuwonus pelamis	"	57.0	44.0
Thunnus albacares	"	84.8	
Scomberomorus commerson	"	62.3	75.0
Sardinella longiceps	Trawl	15.5	15.0
	Ring seine	14.0	15.0
Encrasicholina devisi	Trawl	10.47	6.8
	Ring seine	7.0	6.8
Stolephorus baganensis	Trawl	6.8	6.0
Stolephorus waitei	Trawl	8.8	8.0
Engraulis punctifer	Trawl	7.9	7.0
Stolephorus commersonii	Trawl	9.1	8.0
Megalaspis cordyla	Trawl	20.2	24.5
	Ring seine	22.6	22.5
	Drift gill net	25.5	23.0
Selar crumenopthalmus	Trawl	20.5	20.5
	Drift gill net	23.4	23.5
Decapterus russelli	Trawl	20.3	14.5
Trichiurus lepturus	Trawl	77.0	56.0

- The spawning stock biomass, standing stock biomass and total yield for *C.macrostomus* along the coast of Kerala was estimated as 11,251t, 20,817t and 21,263t.
- The estimated landings of lizardfish during 2005 was 8,542 t, which recorded a decline of 56%. At Cochin an estimated catch of 861 t of lizardfishes were landed and the fishery supported by *Saurida tumbil* (80%) and *S.undosquamis* (19%). Growth parameters of *S.tumbil* studied off Cochin were $L\alpha$ = 520 mm and K= 0.66. Mortality parameters of the species were Z = 2.25; M= 1.15 and F= 1.10.
- Threadfin breams landings declined by about 72% with an estimate of 26,949 t. At Cochin Fisheries Harbour, the threadfin breams landings during 2005 was 1,856 t (6 Kg/hr) which indicated an increase by 4.8% when compared to that of 2004 (1,771 t). *Nemipterus mesoprion* was the dominant species (64%) followed by *N. japonicus*.
- Growth parameters ($L\alpha$ and K) estimated for *N.japonicus* were 338 mm and 0.92/ year, respectively. Z= 5.91/year; M= 0.85/year; F= 5.06/year and Lc = 157.4 mm. Recruitment takes place almost throughout the year with peak from May- September. E= 0.86 which is higher than E_{max} (0.61) indicating that the *N.japonicus* resource off Malabar coast was under intense fishing pressure.
- A total of 97 t of groupers were landed at Vizhinjam by drift gill net (44%) and hooks and lines (56%). *Epinephelus undulosus* was the dominant species landed.An estimated 1518 t of groupers were landed at Cochin by trawlnet, gillnet and hooks and line. The species supported the fishery were *E. diacanthus* (71%), followed by *E.chlorostigma* (16.1%) using trawl net. Of the 10 species caught in the gill net, the dominat species were *E.diacanthus* (24%), *E.chlorostigma* (13%) and *E.longispinus* (11%).

A view of shark, *Carcharhinus limbatus* landed at Kozhikode

- An estimated catch 203.7 t bull's eye (*Priacanthus hamrur*) was landed at Cochin.

Crustacean resources

- The penaeid shrimp landings in the state showed an increase of 3% with an estimate of 31,516 t contributing 6% of the total fish production.
- Penaeid shrimp landings in Malabar area was 8,318 t forming 3.4% of the total production. Mechanized trawler landed 88% of the catch. Among the 13 species landed by trawlers, *Fenneropenaeus indicus* formed 31% followed by *Metapenaeus dobsoni* (30%), *M. monoceros* (16%), *Parapenaeopsis stylifera* (13%), *M. affinis* (4%) and the rest by other species.
- In trawls, total length of *F. indicus* ranged from 71 to 185 mm with a prominent mode at 136 - 140 mm. The gradual decrease in the mean size from January to June indicated recruitment of juveniles into the fishery and that the maximum recruitment had taken place in June.
- *F. indicus* : M = 1.5; Z = 5.65; *M. dobsoni*: M = 1.6; Z = 5.28, *M. monoceros* : M = 1.38; Z = 4.36, *P. stylifera* : M = 1.45; Z = 4.99, *M. affinis* : M = 1.38; Z = 4.5 (M was found out from size at first maturity).
- The biomass was estimated for different species by employing Virtual Population Analysis (Jones cohort analysis): *F. indicus*: 74,195 t ; *M. dobsoni* :13,876 t; in *M. monoceros*:6,905 t; *P. stylifera* :5,131 t and 2,242 t in *M. affinis.*

Minitrawler with otter board and out board engine

- Penaeid shrimp landings at Cochin amounted to 3,663 t with a catch rate of 7 kg/hour showing an increase of 977 t compared to 2004. *M. dobsoni* (63%) and *P. stylifera* (30%) were the dominant species in the fishery. In the case of *P. stylifera* decrease in catch from 3,035 t in 2003 to 1,104 t in 2005 was mainly due to the failure of normal fishery during August-September.
- The estimated deep-sea shrimp landing at Cochin Fisheries Harbour during 2005 was 3,077 t with a catch rate of 75 kg/hr. The catch and catch rate improved by 66% and 9%, respectively in comparison to 2004, probably due to increase in actual fishing hours by 52%. Pandalids contributed 69% of the catch and the rest by penaeids. *Plesionika spinipes* (42%) and *P. martia* (18%) were the main constituents among pandalid shrimps. Important penaeid species were *Metapenaeopsis andamanensis* (23%), *Penaeopsis jerryi* (14 %) and *Aristeus alcocki* (6%).
- The shrimp catch from inshore grounds landed at Sakthikulangara was 5,348 t with catch rate of 9 kg/hour, which showed a decrease of 16% compared to the previous year. *P. stylifera* dominated the catch (66%) followed by *M. dobsoni* (24%), *F. indicus* (3.7%) and *M. monoceros* (3.4%). In comparison to the previous year, deep-sea shrimp catch from *Kollam bank* (9,857 t) landed at Sakthtikulangara declined by 1,644 t (14%). *M. andamanensis* dominated the catch (34%). Pandalid shrimps formed 57% of which *H. gibbosus* and *H. woodmasoni* and *P. spinipes* constituted about 17% each.
- Mini-trawl operations along the Alappuzha coast (Pallithode) in the nearshore waters yielded 208 t of prawns forming 77% of the total mini trawl catch. *P. stylifera* constituted 64% followed by *M. dobsoni*

(35%) of the total mini trawl shrimp catch. The catch was composed mostly of juveniles and sub-adults.

- Operation of mini-trawl in the inshore areas mainly target the shrimps. The area of operation is the nursery ground for *M. dobsoni* and *P. stylifera*. The catch composition clearly showed that the catch was mostly constituted by juveniles and sub-adults. Mini-trawl with mesh size of 15-20 mm is a destructive gear and operation of the net in the inshore nursery areas is detrimental to the shrimp fishery. The declining trend of shallow water shrimp fishery is continuing and operation of this gear needs to be banned for continued sustenance of the inshore shrimp fishery.
- An estimated 5,428 t of edible crabs were landed in Kerala. Total landings of crabs by trawlers at Cochin was 330 t. *Portunus sanguinolentus* and *Charybdis feriatus* dominated the fishery constituting 46% and 29%, respectively, whereas at Kozhikode *P.sanguinolentus* contributed 82% of the fishery.
- The landings of inshore and deep-sea lobsters together showed a decline of 486% with an estimate of 45 t. At Sakthikulangara, 21 t of slipper lobster *Thenus orientalis* was landed with a catch rate of 1 kg/unit. In the lobsters, female maturity is estimated on the basis of females carrying eggs. Higher percent of berried females (>50%) was observed during November to January showing the peak-breeding season for the species.
- The landings of the deep-sea lobster, *Puerulus sewelli* decreased from 255 t in 2004 to 29 t in 2005. The annual mean size (total length) was 127 mm for females and 130 mm for males. In the landings 39% of female lobsters were immature, 8% were in advanced maturity and 19% were fully nature; females in berry constituted 6% and the spent recovering stage 28%.

Molluscan resources

- The cephalopod catch in Kerala showed a 40% decline when compared to 2004, but was only 24% less than the short-term average yield. This was mainly because of the tremendous increase in production (53%) during 2004. Trawlers contributed about 90% of the cephalopod catch.
- Cuttle fish dominated the catch (50%) followed by squids (34%) and octopus (16%). Among cuttle fishes, the *Sepia pharaonis* formed 93% and among squids *Loligo duvauceli* formed 63% of the catch. August and September were the most productive months for cephalopods as evidenced by the high catch rate. Length of *S. pharaonis* ranged from 45-389 mm with multiple modes and peak recruitment to the fishery was observed in January. Peak breeding was observed in August-September for cuttle fish, squids and octopus.
- At Cochin a total yield of *S. pharaonis* was 7% of the standing stock biomass (43,206 t). The numbers recruited into the fishery was estimated as 1,13,096 and the spawning stock biomass was estimated as 40,199 t. The relative fecundity of *S. pharaonis* was estimated as 0.35 eggs/ g body weight.
- An estimated 443 t of cephalopods were exploited by boat seine and

Jigs for catching squids

Unusual occurrence of blow fish

Blow fish *Lagocephalus inermis*

The havoc caused last year by the smooth-backed blowfish, *Lagocephalus inermis* in the fishery sector all along the Kerala coast had been enormous. These fishes were found to mangle various fishing gear, which has resulted in considerable loss in terms of damage to the nets, and to the quality fishes caught (seerfish, squids) and loss of fishing days. However, at a later stage the menace has turned to be a boon at Kozhikode. The fishermen started sundrying the fish in large quantities after removing entrails, deskinning and deheading. The price of this fish for a box of around 50 kg ranged from Rs 4-8/Kg in the landing center.

Introduction of ingenious thermocol fishing craft along the Alappuzha coast

Ingenious thermocol fishing craft

An ingenious thermocol fishing craft introduced along the Alappuzha coast has been found very useful in harnessing the resources such as the oil sardine, other fishes and shrimps occurring in the near-shore waters within 4-6 m depth. The craft mainly employed the ozhukkuvala (mesh size: 28-30 mm) and is operated by one person. The catch of shrimps has been found to be high during the monsoon season. Some of these units realized upto Rs. 8,000 per trip. However, like the minitrawl, their fleet size may increase and could pose threat in the future to the finfishes and shellfishes entering the nursery grounds in the near shore waters.

jigging at Vizhinjam. The squid *L. duvauceli* contributed 339 t (76%) and rest by cuttle fish (*S. pharaonis*). Temporary Fish Aggregating Devices using coconut spadix were deployed at 15-30 m depth off Vizhinjam for catching cuttlefish using jigs.

- The estimated cephalopod catch at Malabar region was 7,543 t. Multiday trawl net contributed 90% of the catch. *S. pharaonis* was the dominant species (42%) followed by *S. aculeata* (17%). Among the squids, *L. duvauceli* was abundant.
- The total bivalve production along the Malabar Coast covering 8 centres was 11,547 t with a catch rate of 64 kg. The green mussel *Perna viridis* constituted 8,693 t forming 75% of the bivalve landings. The clam, *Meretrix casta* is exploited from Chaliyar, Moorad and Dharmadom with a total production of 1,450 t.
- The bivalve production from the inshore and estuarine waters of central and south Kerala was estimated as 61,280t. The black clam *Villorita cyprinoids* from Vembanad lake ecosystem contributed to 75% of the production. Fishery for the yellow-foot clam *Paphia malabarica* mainly took place in Ashtamudi lake to the tune of 10,232 t. Peak recruitment to the fishery took place in January - February following the post-monsoon spawning . In Chettuva estuary 693 t of *Meretrix casta* were exploited and from the inshore areas of Vypin Island 4,604 t of *Suvetta scripta* were harvested. *V.cyprinoids* had a length range of 7-29 mm with multiple modes and peak recruitment was observed during monsoon (July-August) and December.

PROJECT CODE **PEL/IDP/02**
PROJECT TITLE **Appraisal of marine fisheries of Karnataka and Goa**
SCIENTISTS **C. Muthiah,** N.Ramachandran, Prathibha Rohit, P.U.Zacharia, A.P. Dineshbabu, Geetha Sasikumar, M. Srinath and Sally Thomas (CIFT)
CENTRES Operated from Mangalore and Cochin

Tuna catches landed by multiday gillnet/hooks and line units at Mangalore fishing harbour

- The marine fish landings in Karnataka and Goa during 2005 were estimated at 2, 24,041 t and 71,396 t, respectively. As compared to the previous year, the catch increased by 16% in Karnataka but decreased by 14% in Goa.
- Pelagic finfishes, demersal finfishes, crustaceans, cephalopods and otherfishes formed 49%, 13%, 16%, 6% and 16%, respectively in Karnataka and 80%, 15%, 3%, 1% and 0.1 % in Goa.
- In Karnataka, single species supporting major fisheries was oilsardine *Sardinella longiceps*, Indian mackerel *Rastrelliger kanagurta*, ribbonfish *Trichiurus lepturus*, and squilla *Oratosquilla nepa*. These species collectively contributed 42% to the state's total marine fish production.
- In Goa, *S. longiceps* was the most dominant species followed by

Group-wise and year-wise marine fish landings of Karnataka during 2005

Fish groups	Total Catch (t)	Percent	Major gear	Catch (t)	C/E (kg)
Sardines	50394	22.5	PS	29561	765.5
Mackerel	16731	7.5	PS	12640	327.3
Whitebaits	3390	1.5	PS	2234	57.9
Carangids	16855	7.5	PS	6564	170.0
Seerfishes	4728	2.1	GN	2571	81.1
Tunas & billfishes	2425	1.1	PS	1446	37.4
Ribbonfish	15618	7.0	TR	14728	6.1
Threadfin breams	13222	5.9	TR	13212	5.5
Whitefish	1075	0.5	TR	538	0.2
Soles	5102	2.3	TR	5037	2.1
Silverbellies	6058	2.7	RS	3594	101.0
Pomfrets	673	0.3	TR	279	0.1
Penaeid prawns	21507	9.6	RS	10869	305.4
Crabs	1264	0.6	TR	1119	0.5
Stomatopods	12787	5.7	TR	12661	5.2
Cephalopods	13170	5.9	TR	13135	5.4
Others	39042	17.4	RS	17548	493.0
Total	**224041**	**100.0**	TR	95121	39.4

C/E = Catch-per-hr in Trawl (TR)

C/E = Catch-per-unit in Purseseine (PS), Gillnet (GN), and, Ringseine (RS)

R.kanagurta, *T. lepturus* and *S. commerson*. They together constituted about 60% of the marine fish landings of the state, of which the oilsardine alone contributed nearly 40%.

- The marine fish production of Karnataka was contributed by purseseine (25%) ringseine (23%) multi-day trawl (31%), singleday trawl (11%), gillnet (7%) and other gears (3%). In Goa the catch was contributed by purseseine (66%), singleday trawl (18%), multiday trawl (4%) gillnet (13%) and other gears (1%).
- Marine fish landing in Karnataka and Goa exhibited an inverse relationship with regard to the catch of major species/groups *viz*., mackerel, sardines, whitebaits, seerfishes and carangids. While mackerel, seerfishes and carangids recorded a decrease in Karnataka, there was an increase of these groups in Goa. Likewise, sardines and whitebaits recorded an increase in Karnataka but there was a decrease for them in Goa.
- Among the major pelagics exploited by different gears, most of the species had mean size above the minimum size at maturity except *S. longiceps*, *S. commerson*, *D. macrosoma* and *E. affinis* indicating heavy exploitation of young ones of these resources.
- While *R. kanagurta*, *E. devisi*, *E. affinis* and *S. commerson* were exploited at a higher levels and *S. waitei*, *T. lepturus* and *M. cordyla* at an optimal level, *A. thazard* and *S. longiceps* were found to be underexploited.
- Among demersal resources, threadfin breams were the dominant group represented by *N. mesoprion* (74%) and *N. japonicus* (23%). Their

Multiday gillnet/hooks and line units berthed at Mangalore fishing harbour

Mean-size and length at maturity (L_m) of major pelagics

Species	Gear	Mean size	L_m
R. kanagurta	Purseseine	22.0	17.5
	Trawl	22.3	17.5
S. longiceps	Purseseine	13.2	15.0
	Trawl	15.8	15.0
	Ringseine	16.2	15.0
E. devisi	Purseseine	8.1	6.8
	Trawl	8.4	6.8
S. waitei	Trawl	8.8	8.0
S. insularis	Trawl	7.0	6.0
E. punctifer	Purseseine	7.4	7.0
	Trawl	7.3	7.0
M. cordyla	Purseseine	28.7	25.0
	Trawl	22.7	25.0
D. russelli	Trawl	19.1	16.0
D. macrosoma	Trawl	16.1	18.0
S. commerson	Drift gillnet	67.0	70.0
	Trawl	39.0	70.0
	Purseseine	52.0	70.0
E. affinis	Drift gillnet	40.0	43.0
	Purseseine	37.0	43.0
A. thazard	Drift gillnet	36.0	30.5
	Purseseine	32.0	30.5
T. lepturus	Trawl	66.0	60.0

mean size in the fishery was 12.0 mm and 12.9 cm as against the L_m of 17.2 cm and 18.8 cm, respectively.

- Out of five species representing the silverbelly fishery, *Leiognathus bindus* (64%) and *Secutor insidiator* (20.5%) were the dominant species. The mean size was 8.3 cm for *L. bindus* and 9.1cm for *S. insidiator* as against the L_m of 8.6 cm and 7.7 cm, respectively.
- The whitefish fishery was supported by fish with a mean size was 15.1 cm as compared to the L_m of 13.2cm.
- Out of five species in the sole fishery, *C. macrostomus* was the dominant species with a mean size of 12 cm as against the L_m of 11.5 cm.

Growth and mortality parameters of major pelagic species of Karnataka

Species/Parameters	Lα(cm)	K	Z	M	F	E
R. kanagurta	31.8	1.1	6.20	2.10	4.10	0.70
S. longiceps	22.8	0.9	2.74	1.79	0.95	0.34
E. devisi	11.7	1.59	14.8	2.81	11.99	0.77
S. waitei	11.5	1.5	7.17	2.67	4.50	0.57
M. cordyla	49.6	0.7	2.24	1.49	0.75	0.59
S. commerson	155	0.95	7.35	1.86	5.49	0.75
E. affinis	71	0.67	3.99	1.45	2.54	0.64
A. thazard	50	1.1	3.36	2.08	1.28	0.38
T. lepturus	127	0.96	3.90	1.19	2.02	0.52

Stock estimates of the major pelagic species of Karnataka

Species	Gear	Spawning stock (t)	Standing stock (t)	Yield(t)
R. kanagurta	All gears pooled	4212	7491	5080
S. longiceps	"	22971	68437	46460
E. devisi	"	629	1017	1999
M. cordyla	"	4690	6704	1846
S. commerson	Drift gillnet	343	895	2442
	Trawl	5	82	548
	Purseseine	7	183	856
E. affinis	Drift gillnet	303	882	760
	Purseseine	30	661	1343
A. thazard	Drift gillnet	213	274	126
	Purseseine	25	52	94
T. lepturus	Trawl	8566	12574	14708

- Among the demersal species *N. japonicus*, *L. lactarius*, *L. bindus* and *S. insidiator* were found to be exploited at a higher level. The most dominant and economically important species *N. mesoprion* and *C. macrostomus* were found to be optimally exploited.
- The multiday trawl landing of shrimps were represented by nine species of which, *Metapenaeus monoceros* was the dominant species followed by *Solenocera choprai*. In the single day trawl fishing, four species were encountered, of which *M. dobsoni* and *P. stylifera* were important. The growth and mortality parameters of males and females for four species haven been estimated. It showed that while *P. stylifera*, *M. monoceros* and *S. choprai* were exploited at an optimum level, *M. dobsoni* was harvested at a slightly higher level.
- The cephalopod fishery of Karnataka was supported by squid *Loligo duvauceli*, cuttlefish *Sepia pharaonis* and octopus *Octopus membraneous. L. duvauceli* was the dominant species in Goa.
- *S. pharaonis*: Size ranged from 40 to 410 mm with a mean size of 161 mm. The growth parameters and stock parameters were L_{∞} = 387 mm, L_m = 129 mm, L_{opt} = 233 mm K = 0.63, M = 1.391. Spawning stock = 118 t and standing stock = 141 t.
- *L. duvauceli*: Size-range was 20-410 with a mean size of 137 mm. The growth parameters and stock parameters were L_{∞} = 421 mm, L_m = 110 mm, K = 0.9, M = 1.789. Spawning stock = 9,457 t and standing stock = 10,114 t.

Growth and mortality parameters of major demersal finfish species of Karnataka

Species/Parameters	$L\alpha$ (cm)	K	Z	M	F	E
N. mesoprion	31	0.78	3.68	1.53	2.15	0.58
N. japonicus	33.5	0.89	3.26	0.84	2.42	0.74
S. insidiator	12.5	1.1	5.72	1.28	4.44	0.78
L. bindus	13	0.99	5.5	1.18	4.32	0.79
C. macrostomus	17.8	0.95	4.65	2.03	2.62	0.56
L. lactarius	29	1.0	7.3	1.83	5.47	0.75

Stock estimates of the major demersal finfish species of Karnataka

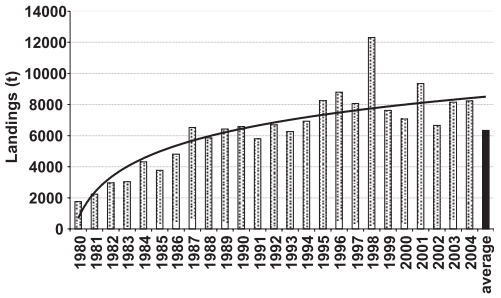
Species	Gear	Spawning stock (t)	Standing stock (t)	Yield (t)
N. mesoprion	Trawl	1291	4943	10206
N. japonicus	Trawl	1375	2819	3589
S. insidiator	Trawl	293	382	309
L. bindus	Trawl	227	1218	1191
C. macrostomus	Trawl	1498	4994	1173
L. lactarius	Trawl	198	322	634

- Clam catch from the estuaries of Karnataka amounted to 13,488 t. Out of four species, *viz.*, *Meretrix casta* and *Paphia malabarica* were the dominant species.
- The mussel landing in Karnataka was estimated as 9,627 t of which nearly 80% of the production (7,835 t) came from the southern Karnataka coast. *Perna viridis* was only species in the fishery. Its size ranged from 7 mm to 125 mm with a mean of 62 mm.
- A targeted gastropod fishery is reported from Malpe. The annual catch was estimated at 179 t.

Growth and mortality parameters of major shrimp species of Karnataka

Species	Sex	Lα (cm)	K	t_0	Z	M	F	E
P. stylifera	Male	98	1.3	-0.035	4.20	2.40	1.80	0.43
	Female	123	1.5	-0.025	4.50	2.67	1.83	0.41
M. monoceros	Male	150	1.4	-0.027	4.75	2.52	2.23	0.47
	Female	192	1.6	-0.2	5.76	2.82	2.94	0.51
S. choprai	Sexpooled	99	1.1	-0.045	5.31	2.20	3.11	0.59
		120	1.2	-0.038				
M.dobsoni	Male	97	1.0	-0.052	5.22	1.94	3.28	0.63
	Female	119	1.2	-0.038	5.38	2.23	3.15	0.59

PROJECT CODE **PEL/IDP/03**
PROJECT TITLE **Appraisal of marine fisheries of Lakshadweep**
SCIENTIST **K.P.Said Koya**
CENTRE Minicoy

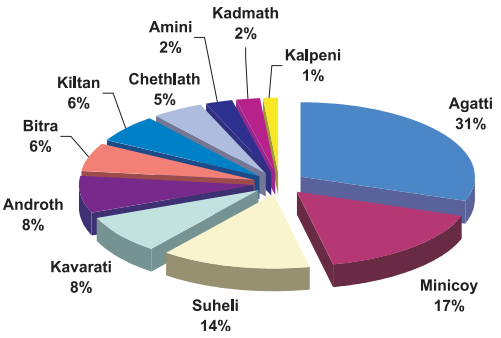


Tuna landing from Lakshadweep during 1980-2004

- The estimated marine fishery resource potential in the Lakshadweep waters is about 50,000 to 1,40,000 against the present estimated average annual production of 10,000 t.
- The fishing activities in Lakshadweep are concentrated in all the 11 inhabited islands and an uninhabited island, Suheli. The main resources currently exploited are tuna and tuna-like fishes. Of these, skipjack, *Katsuwonus pelamis* is the major species on which the commercial fishery is established. In addition to the tunas, flying fishes, barracuda, seerfish, sailfish, dolphinfish, rainbow runner, garfishes, half beaks, snappers, perches and other reef fishes, sharks, rays, trigger fishes, octopus etc. also form the fishery.
- During the period 1980 to 2004, annual tuna landings in the Lakshadweep islands ranged between 1,760 t (1980) and 12,300 t

(1998) with an average of 6,340 t against a projected annual potential varying between 50,000 and 90,000 t. The major contribution to the tuna landings came from Agatti (31%), Suheli (14%), Minicoy (17%), Kavarati and Androth (8%).

- Tuna landings at Minicoy were estimated to be 2,537t showing a marginal decline of 1.5 % compared to 2004. The major tuna species landed was *K. pelamis* (86%) followed by *T. albacares* (12%) and the rest was *E. affinis.* Pole & lines accounted for 97% of the total tuna landings followed by troll lines. About 300 boats are annually in operation for pole and line tuna fishing during the last 15 years. Pole & line-fishing boats (OAL of 25-36') mostly conduct single day fishing trips and often operate 2 trips during the peak season.
- *K. pelamis* was found to attain first maturity at 44 cm and *T. albacares* at 102 cm. Therefore catching *K. pelamis* above 45 cm and *T. albacares* above 105 cm would allow them to spawn at least once and would help in sustaining the stock.
- Since 1994, tuna catches and catch rates from Androth have increased due to adoption of drift gillnetting as well as fishing in distant fishing grounds such as Elikalpeni Bank.
- A total of 28 FADs out of the proposed 40 nos by Department of Fisheries had been deployed in Lakshadweep waters during February 2006. Assured catches from the FAD sites made the fishermen to venture to these distant fishing grounds with the help of GPS.



Island-wise tuna landings in Lakshadweep

PROJECT CODE	**DEM/IDP/01**
PROJECT TITLE	**Appraisal of marine fisheries of Gujarat**
SCIENTISTS	**K.V. Somasekharan Nair,** P.K. Asokan, K. Balan, V.P.Vipin Kumar and K. Madhu (CIFT)
CENTRES	Operated from Veraval and Cochin

- During 2005, the estimated marine fish landings at Gujarat was 3.56 lakh tonnes, which is a decline by 13% from that of 2004.
- The landings by multiday trawlers was estimated as 1,48,197 t for an effort of 34,04,696 (43.5 kg/hr). The single-day trawlers landed 47,921 t at a catch rate of 38.0 kg/hr. There was no trawling during June-August due to the fishing ban imposed by the state government. Compared to 2004, the trawl effort and catch decreased by 21%.
- The landings by the mechanized gill netters was 15,682 t (280 kg/unit). Compared to 2004, the effort decreased by 40% and the catch by 30%.
- In the mechanized dol netters, the catch was 1,06,585 t (710 kg/unit). Compared to 2004, the effort increased by 61% and the catch by 41%.
- The pelagic landings formed 42% (1,51,293 t) followed by demersals (1,01,318 t; 28%), crustaceans (76750 t; 22%) and cephalopods (27,718 t; 8%).
- Bombayduck (*Harpadon nehereus*) formed 33% of the pelagic landings followed by ribbonfishes (27%), seerfishes and tunas.
- The major demersal resources were the sciaenids (33% of demersal

Population parameters of species along Gujarat coast

Species	Length at maturity (cm)	Length at infinity (cm)	K	M	Z
Pelagics					
Scomberomorus guttatus	40	59	0.33	0.948	
Thunnus tonggol	50	99	0.31	0.919	
Katsuwonus pelamis	43	73	0.96	1.878	
Euthynnus affinis	50	65	0.47	1.155	
Auxis thazard	30	45	0.78	1.612	
Harpadon nehereus	21	33	1.2	2.232	
Trichiurus lepturus	37	120	0.99	0.742	
Demersals					
Nemipterus japonicus	14.5	32	0.6	1.347	
Nemipterus mesoprion	12.5	30	0.65	1.42	
Otolithes cuvieri	16	38	0.55	1.273	
Johnius glaucus	28.2	14	0.27	0.86	
Saurida tumbil	57.7	29	0.7	1.494	
Pampus argenteus	38.4	18	0.24	0.817	
Crustaceans					
Parapenaeopsis hardwickii		12.2	0.3	0.54	0.62
Metapenaeus kutchensis		17	0.32	0.51	1.28
Metapenaeus monoceros		21.8	0.28	0.44	1.68
Penaeus semisulcatus		27	0.19	0.32	1.75
Parapenaeopsis stylifera		14.1	0.41	0.64	2.28
Solenocera choprai		13.1	0.21	0.42	0.87
Solenocera crassicornis		12	0.39	0.58	1.63
Nematopalaemon tenuipes		7.7	0.32	0.64	0.87
Exhippolismata ensirostris		10	1.2	1.41	3.38
Charybdis feriatus		9.1	1.3	1.53	2.32
Thenus orientalis		10.5	0.35	0.62	2.102
Panulirus polyphagus		13.8	0.45	0.68	4.384
Cephalopod					
Loligo duvauceli		23.1	1.00	1.01	2.64

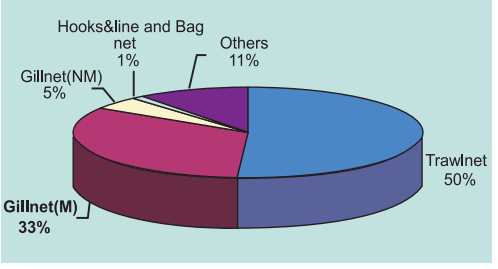
landings) followed by threadfin breams (15%), catfishes (11%) and lizardfishes (9%).

- Penaeid prawns formed 21% of the total crustacean landings and non-penaeid prawns 65%; *Acetes* sp contributed 70% to the non-penaeid prawn landings.
- The cephalopod landings was constituted by *Loligo duvauceli*, *Sepia pharaonis* and *S. aculeata*. An alarming feature of the cephalopod fishery was the capture and export of juvenile squids (< 5 g weight) commonly called “nipple squids”, which is a threat to sustenance of the fishery.

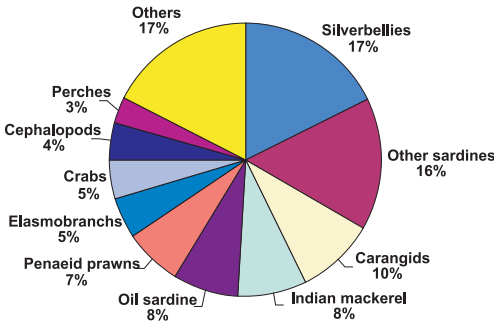
- Growth parameters were estimated for 7 species of pelagic fishes, 6 demersal fish species, 7 species of penaeid prawns, 2 species of non-penaeid prawns, one species each of crab, sand lobster, spiny lobster and squid.
- Virtual Population Analysis was carried out on a number of species. The seerfish *Scomberomorus commerson*, the tunas *Thunnus tonggol*, *Katsuwonus pelamis*, *Euthynnus affinis* and the ribbonfish *Trichiurus lepturus* are overexploited.
- The stocks of bombayduck *Harpadon nehereus*, the threadfin breams *Nemipterus japonicus* and *N. mesoprion*, the sciaenids *Otolithus cuvieri* and *Johnius glaucus*, the lizardfishes *Saurida tumbil* and *S. undosquamis* and the penaeid shrimps are exploited at an optimum level.

PROJECT CODE	**DEM/IDP/02**
PROJECT TITLE	**Appraisal of marine fisheries of Tamil Nadu and Pondicherry**
SCIENTISTS	**G.Mohanraj,** H. Mohamad Kasim, P.V. Sreenivasan, S. Lakshmi Pillai, T.V. Sathianandan, Wilson T. Mathew, P. Swathi Lekshmi, A.Raju, M. Rajamani, V. Venkatesan, A.C.C.Victor, I. Jagadis, E.M. Abdussamad and M.P. Ramesan
CENTRES	Chennai, Mandapam and Tuticorin

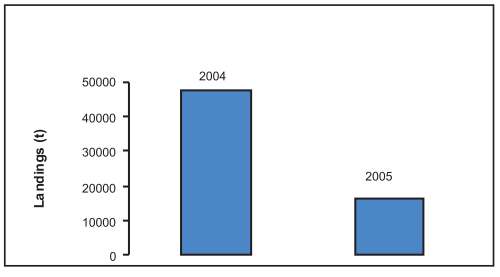
- The estimated marine fish landings of Tamil Nadu were 2,81,268 t during 2005. The catch declined substantially by 28.4% from that of 2004. Fishing activity was affected in the first quarter of 2005 after the December 2004 tsunami. Mechanised fishing was banned for 45 days during April 15 – May 30.
- Mechanized trawlers (34.3%) and outboard gill netters (25.4%) contributed nearly 60% to the catch.
- Pelagic (48%) and demersal fishes (31%) were the major components followed by crustaceans (15%) and molluscs (6%).
- Among the pelagics, sardines dominated the fishery with 33.7% (34,129 t) of the pelagic landings followed by carangids (20,746 t, 20.5%).
- Among the demersals, the silverbellies (38,663 t, 51.8% of demersal fishes), followed by elasmobranchs (10,689 t, 14.3%), goatfishes (8121t, 10.9%) and sciaenids (6626t, 8.8%) were the major groups.
- Crustaceans were contributed mainly by penaeid prawns (14,902t, 58%) and by crabs (10,386t, 40.6%).
- Cephalopods contributed 92% to the molluscan landings (10,477 t).
- At Pondicherry, the total marine landings was 10,819 t during 2005, which formed 0.5% of the all India marine fish landings. Oil sardine (5027 t, 46.5%) and mackerel (1594 t, 14.7%) dominated the fishery.
- The dominant species in the fishery at Chennai were *Scomberomorus commerson*, *Sardinella gibbosa*, *Katsuwonus pelamis*, *Rastrelliger kanagurta*, *Trichiurus lepturus* and *Stolephorus indicus* among the pelagics, *Himantura jenkinsii*, *Upeneus taeniopterus*, *Nemipterus mesoprion* and *Saurida undosquamis* among the demersal fishes, *Metapenaeus dobsoni*, *Portunus sanguinolentus* and *Panulirus homarus* among the crustaceans and *Sepia pharaonis* among the cephalopods.



Gearwise catch during 2005 in Tamil Nadu



Major resource group in Tamil Nadu during 2005



Annual landings (t) along Cuddalore coast in the pre and post tsunami periods

Impact of Tsunami:

- As fishing was affected for three months (January-March 2005) after the tsunami, only 11% of the annual fish landings was during the first quarter along the Tamil Nadu coast.
- The impact of December 2004 tsunami was assessed by comparing the fishery at one of the affected areas, namely, Cuddalore district during the year 2004 and 2005. At Cuddalore, there was no fishing for three months after tsunami (January-March 2005) which is evident by the reduction in the annual fishing effort from 1,24,364 units (actual fishing hours: 4,76,438) in 2004 to 54,140 units in 2005 (actual fishing hours: 2,78,798). The landings declined from 47,503 t to 16,466 t (decrease by 65.3%).
- The landings of sharks, rays, eels, catfishes, oil sardine, whitebaits, flying fishes, groupers, goatfishes, carangids, silverbellies, mackerel, seerfishes, skipjack tuna, soles, crabs and stomatopods declined in the post-tsunami period whereas landings of lizardfishes and cephalopods increased.
- At Chennai, there was no trawling during January-March 2005. During these three months, the indigenous trammel net (mani valai) landed large quantities of shrimps (monthly landings: 1000 to 3500 t) consisting of *Fenneropenaeus merguiensis*, *P. monodon*, and *Metapenaeus monoceros* in addition to the common species, namely *F. indicus*.

Stock assessment of major exploited resources of Tamil Nadu during 2005

Resource	Present yield (t)	Potential yield(t)	Standing stock biomass (t)
Chennai			
Scomberomorus commerson	89	59	66
Scomberomorus guttatus	37	31	50
Saurida undosquamis	454	447	796
Parapenaeopsis maxillipedo	196	177	197
Metapenaeopsis stridulans	130	157	230
Portunus sanguinolentus	252	265	435
Doryteuthis sibogae	34	383	501
Mandapam			
Penaeus semisulcatus	725	911	1015
Portunus pelagicus	297	408	4911
Tuticorin			
Sardinella gibbosa	1063	2511	1378
S. longiceps	166	246	266
S. albella	375	372	525
S. sirm	487	1144	376
Rastrelliger kanagurta	296	1072	1726
Euthynnus affinis	600	557	713
Auxis thazard	228	448	433
Scomberomorous commerson	300	734	219
Selaroides leptolepis	20	227	150
Caranx ignobilis	137	279	308

PROJECT CODE	**DEM/IDP/03**
PROJECT TITLE	**Appraisal of marine fisheries of Orissa**
SCIENTISTS	**S.Sivakami,** G. Maheshwaradu, Sheela Immanuel, Somy Kuriakose and G. Rajeswari (CIFT)
CENTRES	Operated from Cochin and Visakhapatnam

- The estimated marine fish landings in Orissa were 1,01,500 t during 2005.
- Mechanised fishing was banned for 45 days during April 15 – May 30. Maximum number of units was operated during January and the least during April and June.
- The landings were higher during November - January and July – August.
- Pelagic fishes contributed 43% (43,791 t), demersal fishes 38% (38,750 t) and crustaceans & cephalopods 18% (18,487 t) to the total landings.
- Pelagic fish landings were high during December, November and January; low catch was realized during June. Demersal fishes were landed in good quantities during August, October and December; lean months were April and June. Crustaceans and cephalopod landings were high from July to November.
- A total of 17 different types of gears were operated off Orissa.
- Motorised craft, which operated drift gillnet, bottomset gillnet and hooks & line expended the maximum effort in terms of unit operation (2,74,346 units). In terms of fishing hours, however, the mechanized craft expended maximum effort (18,03,351 h).
- Pelagic fishes were represented mainly by ribbonfishes, lesser sardines, horse mackerel and whitebaits. Ribbonfishes were landed more during November- December by the trawlers and gillnetters; and carangids were landed more during July by the trawlers and during November and December by gillnetters.
- The major groups of demersal fishes were sciaenids, catfishes and pomfrets. The sciaenids were landed more during October-February while catfishes were landed more during July-January period. Peak landing of pomfrets was during October-March.
- Penaeid prawns were landed more during July-January.

PROJECT CODE	**CF/IDP/01**
PROJECT TITLE	**Impact of selective fishing of juvenile and brood fish, FADs and searanching on stock health**
SCIENTISTS	**E.V. Radhakrishnan,** A.P. Dineshbabu, K.K.Philipose, Mary K. Manisseri, J. Jayasankar, M. Rajamani, K.R.Manmadhan Nair, H. Mohamad Kasim, G. Mohanraj, S. Lakshmi Pillai, K.P. Said Koya, E. Dhanwanthari, I. Jagadis and M. Zaffar Khan
CENTRES	Cochin, Mangalore, Kozhikode, Mandapam, Chennai, Minicoy, Visakhapatnam, Tuticorin and Mumbai

During this year, monitoring of fish catch from FADs, studies on selective fishing of juveniles by specific gears and estimation of juvenile component of trawl fishery were carried out.

Juvenile shrimp fishery

Juvenile shrimps form substantial portion of minitrawl catch in Kerala and *thalluvalai* catch from southern Tamilnadu coast.

Destructive fishing gears: threat to the fishery resources.

Minitrawls, thalluvalai and stakenets catch and destroy large quantities of juvenile fishes, shrimps and crabs. These gears are operated in the inshore nursery ground and are a major threat for sustenance of shrimp fishery. Along the Mangalore-Malpe sector, study shows that > 50% of 8 species of fishes landed by trawlers are juveniles. Strict enforcement of mesh size regulations and ban on destructive fishing practices are the management measures recommended.

Juvenile sciaenids landed by trawlers at Mangalore

Minitrawl fishery

- 3716 units of minitrawls operating in inshore areas along the Alappuzha-Cochin coast landed 208 t of shrimps and 62 t of crabs and fish with a total catch rate of 72.6 kg/unit.
- *Metapenaeus dobsoni* (35%) and *Parapenaeopsis stylifera* (64%) were the major species constituting the shrimp fishery. Highest percentage of *M. dobsoni* occurred during March and April (71.4%) and *P. stylifera* during December (70%).
- Juveniles of *M. dobsoni* (<65 mm total length) constituted 40 % of the catch during peak fishing months. Similarly, 33% of *P. stylifera* landed was juveniles (below 70 mm total length). This figure is exclusive of smaller shrimps below 45 mm TL discarded by fishermen.
- Minitrawls mainly target the shrimps and trawling in the nursery areas is detrimental to the shrimp fishery of southern Kerala. This being a destructive gear, ban on this gear is recommended.
- Minitrawling along Alappuzha-Cochin coast landed 23t of crabs at a catch rate of 0.78 kg/hr. *P. sanguinolentus* (74%) dominated the fishery followed by *P. pelagicus* (22%). Major catch of the former species was during postmonsoon months and the latter during premonsoon period.
- Annual mean length for males and females was 95.3 mm and 93.1 mm, respectively. Fifty five percent of female crabs were in immature stage. During January-February, 700 kg of *Charybdis lucifera* were landed. This is an emerging fishery. Stake nets landed 17 t of juvenile crabs at Thevara, Cochin. *P. pelagicus* (68%) and *P. sanguinolentus* were the two major species.
- Seventy one percent of females were in immature stage and males dominated the fishery.

***Thalluvalai* fishery**

- At Mandapam (Thoppukad), *thalluvalai* landed 4.6 t of *P. semisulcatus* with a CPUE of 0.3 kg/hr.
- The total length (TL) of males and females in the fishery ranged from 70 to 150 mm and 70 to 144 mm, respectively. Annual mean length of females was 101.4 mm TL.
- Among the male shrimps landed, 75% were juveniles (<100 mm TL) and among females, 53% were juveniles.

Exploitation of juvenile fishes by commercial trawlers

- Trawl landings of Mangalore-Malpe sector were analysed to study the incidence of juveniles in the commercial fishery. Out of 31 finfish species observed, juveniles constituted an average of 50% of the catch of 8 species of fishes.
- A total of 3717 t of juvenile groupers 60-89 % which constitute total of *Epinephelus* spp. catch were caught.
- Eighty percent of the catch of *Nemipterus mesoprion* were juveniles. Juveniles of *Trichiurus lepturus* amounting to 5315 t were landed.
- Juveniles of *Sardinella longiceps* formed 58% of its catch in purse seines. Sixty three percent of *Megalaspis cordyla* were juveniles.
- In ring-seine majority of finfishes landed were juveniles but may

Percentage and quantity of juveniles of commercially important species caught in trawl, purse-seine and ring- seines landed at Mangalore and Malpe (combined) during January-December 2005

Species	Total catch (kg)	Juvenile catch (kg)	%
Gear: TRAWL			
Cynoglossus macrostomus	1340807	474109	**35.36**
Lactarius lactarius	110898	26815	**24.18**
Scomberomorus commerson	58212	19431	**33.38**
Nemipterus mesoprion	1144722	915777	**80.0**
Trichurus lepturus	11970434	5314873	**44.4**
Sardinella longiceps	717544	171493	**23.9**
Johnius glaucus	135197	40559	**30.0**
Johnius carouna	2457	737	**30.0**
Johnius dussumieri	55432	16630	**30.0**
Otolithus rubber	46806	23403	**50.0**
Saurida undosquamis	112796	45118	**40.0**
Saurida tumbil	206967	82787	**40.0**
Megalaspis cordyla	303089	190037	**62.7**
Decapterus macrosoma	239276	186875	**78.1**
Epinephelus diacanthus	3810389	3238831	**85.0**
Epinephelus epistictus	236129	141677	**60.0**
Epinephelus modestus	528763	317258	**60.0**
Epinephelus chlorostigma	66388	19917	**30.0**
Parastromateus niger	82900	16580	**20.0**
Encrasicholina punctifer	667	217	**32.6**
Leiognathus bindus	244819	73446	**30**
Leiognathus splendens	25349	2535	**10**
Secutor insidiator	68804	27522	**40**
Secutor ruconius	9054	5432	**60**
Gear: PURSE-SEINE			
Sardinella longiceps	4617881	2664517	**57.7**
Megalaspis cordyla	1161987	730890	**62.9**
Gear: RING-SEINE			
Sardinella longiceps	957643	316980	**33.1**
Rastrelliger kanagurta	8330	1166	**14**

not impact the fishery significantly as only small quantities are landed and operation is restricted to certain months.

- Destruction of juveniles of fishes in such magnitude by commercial trawlers is detrimental to the stock. Bycatch reduction devices in trawl nets and strict enforcement of mesh regulations by State Government are necessary for sustenance of marine fishery in Karnataka.

Juveniles of *Epinephelus* sp. landed by trawlers at Mangalore

Searanching

Pearl oyster

- At Tuticorin, 60,000 spats (2-3 mm)of *Pinctada fucata* were produced in the hatchery and transplanted to the farm to grow to juvenile size and for searanching.
- Three sites at depth ranges of 16-18m were surveyed near Kudamutti par to identify suitable location for searanching. No oysters were available in this area.

Green tiger shrimp *Penaeus semisulcatus*

- Two experiments in nursery rearing of hatchery produced postlarvae (PL_{10}) of *P. semisulcatus* were carried out at Mandapam. Commercial larval feed FRIPPAK was used for feeding. From 3,48,700 PL_1 stocked, 1,15,000 PL_{10} were harvested at a survival of 32.3%. In the second experiment out of 4,52,200 PL_1 stocked, 67,800 PL_1 were obtained with a survival of 15%. A total of 4.3 million postlarvae (PL_{10}) were searanched in Gulf of Mannar.

Fish Aggregating Devices (FAD)

FADs of Chennai

- Fish catch from FADs deployed off Chinnandikuppam, Nainarkuppam and Chinnaneelankarai near Chennai was monitored. One FAD was launched by CMFRI at a cost of Rs.2.5 lakhs and two others were deployed by fishermen themselves.
- At Chinnandikuppam, hooks and lines operated at the FAD site landed an estimated 1154 kg of perches with a CPUE of 6.9 kg during September-December.
- An estimated catch of 829 kg of rays and 2115 kg of sciaenids were landed by gillnets in the vicinity of FADs. Hook and line catch from FADs was of high quality perches such as *Lethrinus* spp. and *Lutjanus* sp. which fetch higher price than sciaenids.
- FADs attract fish populations and thereby increase coastal productivity and boost the income of fishermen.

FADs of Lakshadweep

- Twenty eight FADs out of the proposed 40 FADs were deployed in February 2006 at a depth of less than 1000 m by Lakshadweep Island Administration. However, many of the FADs were lost.
- For targeting tuna, ideal depth and distance for stability, productivity and economy of FADs will be around 2000 m depth and 7-10 nautical miles off western side of the islands in the natural migration paths.
- Out of 3 FADs deployed west of Light House and Viringly Island in less than 1000 m, only one is in position. Aggregation of fishes such as *Elegatis*, sp. *Coryphaena* sp. *Chorinemus* sp., and some bait fishes were reported around the FADs.
- Floating data buoys redeployed by NIOT in 2003-04 off Minicoy at a depth range of 2000 m continued to support good tuna fishery. Total yield by pole and lines from the buoys were 1692 t (99.7%) with an average catch rate of 663 kg/unit and the rest was by troll lines.
- In both pole and line and troll lines *Katsuwonus pelamis* was the most important species followed by *Thunnus albacares*.
- The mean size of *K. pelamis* was 22 cm in fork length (FL) and major modes were at 46 cm and 42 cm. Thirty five percent of fishes caught were immature ones (< 45 cm) and the maximum number of juveniles occurred during November. Since brooders escape fishing, spawning stock is protected.
- Size of *T. albacares* caught varied from 26-70 cm in FL. The entire catch of 0.82 lakh numbers were immature fish.

Fish Aggregating Devices

Hooks and lines operated by fishermen on FADs brought high value fishes compared to the fishes from outside the FAD areas. FADs attract fish populations and seem to be beneficial to the fishermen. The proposed establishment of FADs off selected villages along the Tamilnadu coast will give more information on community structure assemblages, aggregation of fish populations and reef productivity.

Artificial reefs

- Bottom set gill nets operated around the reefs landed 55.7 t of fishes at Thikkody, 85.3 t at Dharmadom and 67.8 t at Muttom with a catch rate of 4.4 kg, 5.0 and 5.9 kg/unit, respectively. Lobsters and perches mostly constituted the fishery.

Collection and trade of *Penaeus monodon* brooders

- *Penaeus monodon* formed 6% of the total penaeid shrimp catch in Chennai.
- Price of gravid females ranged from Rs.200-8000 and of spent specimen, Rs.150-700/per piece. Percentage of gravid females in the fishery was 64.1%.
- *P. monodon* constituted 2% and 4% of the catches from small mechanized and sona boats at Visakhapatnam, respectively.
- The length range of female brooders was 198 - 298 mm in total length. Maximum number of brooders were landed in July. No increase in the number of gravid females was noticed between July-October months.
- 'Empties' are sold in a range of Rs.400-500/- and the 'Stages' from Rs.500/- to 1200/-. The price of gravid females has fallen from Rs.40,000 in 2001-02 to Rs.2500/- during this year and the fall in price was due to incidence of WSSV and *Monodon Baculovirus* (MBV) which has resulted in collapse of shrimp aquaculture along the East coast.

PROJECT CODE	**CF/IDP/02**
PROJECT TITLE	**Studies on discards and low-value bycatch of trawlers**
SCIENTISTS	**G.Nandakumar,** K.V.Somasekharan Nair, Miriam Paul, Paramitha Banerji, S.Sivakami, T.S.Velayudhan, J.Jayasankar, Rekha Devi Chakraborthy, P.V.Sreenivasan, Lakshmi Pillai, G.Mohan Raj and G.Maheswarudu
CENTRES	Veraval, Mumbai, Cochin, Chennai and Visakhapatanam

This new Research Project was initiated from July 2005 in five centres along the Indian coast.

Veraval

- The low-value bycatch landed by trawlers locally known as 'kutta' formed about 23% of the multiday trawl catch at Veraval. The total estimated low-value bycatch landing during September-December 2005 amounted to 31,716 t and the monthly catch varied from 1,244 t in September to 11,294 t in November.
- Since the multi-day trawlers were operating for 6-10 days the bycatch landed was in a highly decomposed state and the percentage of unidentifiable group reaching as high as 70% in October. The dominant groups recorded in bycatches were *Acetes* sp. (19.3%), *Secutor insidiator* (19%), followed by crabs (*C. feriatus, C. lucifera, C. laphous* - 6%), juveniles of sciaenids, ribbonfishes, flat fishes, eels, clupeids and anchovies, threadfin breams, goat fishes, lizard fishes, carangids, silver bellies, flat heads, puffer fishes, Bombay duck, small sized shrimps, small squids and cuttle fishes.
- Among sciaenids (*Otolithes cuvieri*, *Johnius glaucus*), the entire

catch was constituted by juveniles. In *Johnieops sina*, *Priacanthus hamrur, Trichiurus lepturus* etc more than 40% of the catch was constituted by juveniles. Entire catch of non-penaeid shrimps such as *Exhippolismata ensirostris* and *Nematopalaemon tenuipes* consisted of juveniles.

- The high percentage of low-value bycatch is mainly due to continued and indiscriminate use of small cod end mesh by the trawlers, which is causing havoc to the commercial fishery of the state.

Mumbai

- The estimated low-value bycatch landed at Mumbai during September-December 2005 was 2,084 t with a catch rate of 4.39 kg/hr. Maximum catch (1,152 t) and catch rate (9.15 kg) were observed in September.
- *Otolithes cuvieri* (25%), which occurred in the bycatch in all the months under observation was followed by *Harpiosquilla harpax* (10%), *Cynoglossus macrostomus* (6.2%), *Apogon* sp. (4.5%), *Johnieops vogleri* nee *borneensis* (4%) among many others.
- The study revealed that most of the species of fish except a few represented in the low-value by catch and discards were below their sizes at first maturity and were hence 100% juveniles. Percentages of juveniles among the exceptions were *Coilia dussumieri* (81.3%), *Decapterus russelli* (80%), *O. cuvieri* (99%) and *J. borneensis* (95%).

Maximum landing of low-value bycatch (31716 t) with catch rate of 11.74 kg per hour was recorded at Veraval during September-December 2005, mainly due to continued and indiscriminate usage of small cod end mesh in the trawl nets operated. The low-value bycatch landed along the Indian coast was contributed mainly by juveniles of sciaenids, silver bellies, flat fishes, threadfin breams, gobids, Acetes *spp., squilla, crabs, non-penaeid shrimps and molluscan shells. The low-value bycatch and discards in the total catch constituted between 4.9% (Chennai) and 34.7% (Visakhapatnam).*

Sakthikulangara-Neendakara

- Observations were made on the fish landings by mechanized trawlers operating for single day fishing, at Sakthikulangara-Neendakara centres. The estimated low-value bycatch landed at these centres during August- December 2005 was 1554 t with catch rate of 13.6 kg/h.
- Multiday fishing units discard the entire low-value bycatch at sea itself due to lack of storage facility and ice stored on board is used for preservation of shrimps and cephalopods.
- The bycatch showed a declining trend between August (581t) and December (138t). The composition of bycatch in total landings ranged between 17% during December and 41% during November, with an average contribution of 21.5%.
- Details on discard at sea was collected on enquiry and the estimated discard during August – December was 851 t with catch rate of 7.5 kg/h. The maximum quantity of discard (654 t) forming 77% of total discard was recorded in August which was the beginning of the fishing season after the trawling ban.
- The low-value bycatch (1554t) consisted of fishes (685t ; 44.1%) crustaceans (693t ; 44.6%) and molluscans (176t ; 11.3%). Juveniles of spiny cheek grouper *Epinephelus diacanthus* landed in good quantities during September-October forming about half of the fish catch.
- *Sardinella longiceps* (length range 75 – 155 mm) landed during December consisted of 97% juveniles. Ribbon fish juveniles obtained during November had a total length of 255mm.

- *Nemipterus mesoprion*, *J. sina* and *O. cuvieri* landed as low-value bycatch were below the size at maturity.
- The monthly catch of crustaceans varied between 49 t in December and 317 t in August.
- The mantis shrimp, *Oratosquilla nepa* (length range 42-106 mm) dominated the crustacean catch forming 67%.
- Spider crabs (23%), *Parapenaeopsis acclivirostris* (5%) in the size range of 45-60 mm and juvenile crabs (5%) consisting of *Charybdis feriatus* (33-52 mm), *C. lucifera* (15-35 mm) and *Portunus sanguinolentus* (30-65 mm) constituted rest of the low-value crustacean bycatch.
- Maximum landings of molluscs (103 t) mainly consisting of gastropods were observed in August with minimum quantity (7.7 t) in December.
- The molluscan bycatch was dominated by *Babylonia* sp. (50%) followed by *Bursa* sp. (13%), *Murex* sp. (9%), *Ficus* sp. (8%), *Tibia* sp. (6.5%) and *Turitella* sp. (6.2%).
- The average price of low-value bycatch was Rs.7/kg and the value of low-value bycatch landed at Sakthikulangara-Neendakara centres by single day fishing trawlers amounted to 10.88 million rupees during August-December '05.

Low-value bycatch landed by trawlers

Chennai

- At Chennai Fisheries Harbour trawlers landed an estimated 484 t of low-value bycatch during July-December '05, which constituted 4.93% of the total landings with cph of 1.89 kg.
- Fishes contributed 223 t which formed 46% of total low-value bycatch. Out of the 64 species recorded during July-December '05, *Pomadaysis hasta* (11.2%) dominated in July, gobid fish (20.3%) in August, *Triacanthus* sp. (14.6%) in September, *Platycephalus crocodylus* (29.2%) in October, *Trichiurus lepturus* (47.9%) in November and *Cynoglossus* sp. (27.9%) in December.
- Crustacean catch amounted to 205 t, of which crabs dominated with 59.8% contribution followed by stomatopods (17.6%), shrimps (14.9%) and lobsters (7.6%).
- Among shrimps, penaeids formed 72.6% and non-penaeids 27.4%.
- *Solenocera crassicornis* (22.2%) *Metapenaeopsis stridulans* (16.5%), *Metapenaeus dobsoni* (14.3%), *Sicyonia lancifera* (9.5%) and *Parapenaeus longipes* (6.5%) were the main penaeid constituents and *Acetes* spp. contributed 18.2%.
- *Charybdis natator*, *Portunus gladiator*, *C. hoplites*, *P. argentatus*, *P. sanguinolentus* and *Dromia dehani* were the crabs observed in the order of abundance. *Oratosquilla nepa* (55.5%) dominated the stomatopod catch.
- Juvenile composition of *P. sanguinolentus* (15-35 mm) was 100% in July, 61% in September and 28% in November.
- Among shrimps, juveniles of *P. longipes* formed 50% of its catch in

August, and 27% in October. Juveniles of *M. dobsoni* formed 50% in October, 20% in November and 30% in December. Juvenile composition of *S. crassicornis* was 28% in October and 25% in November.

- Contribution of molluscs in total bycatch was 13.8 t (2.84%). Maximum catch (5.7 t) was recorded in the month of December and the lowest in November (0.7 t).
- The molluscan catch consisted of fifteen species - 3 species of bivalves, 5 species of gastropods and 7 species of cephalopods.
- Bivalves dominated the catch in August, gastropods in July and December and cephalopods in September, October and November. Most of the individuals among gastropods and cephalopods were juveniles.

Visakhapatnam

- The estimated low-value bycatch landed at Visakhapatnam Fishing Harbour was 534 t during July-December '05 with cph of 0.9 kg which formed 2.6% of total landing. The catch rate of bycatch was higher during July-September (1.15-1.58 kg/h).
- The discards at sea based on enquiry were estimated as 6730 t (cph: 11.3 kg) which amounted to 32.2% of total landing. The bycatch and discards together (7264 t) accounted for 34.7% of total landing of trawlers.
- Low-value bycatch was constituted by finfishes (51%), crustaceans (39.4%) and molluscs (9.6%).
- Of the 25 genera/species of finfishes represented in the low-value bycatch, *Nemipterus* spp (7.2%), dominated followed by *Apogon* spp., *Pennahia macropthalmus*, *Platycephalus* spp. and eels.
- Eleven species of crustaceans were observed in the low-value bycatch. Crabs, *Charybdis truncata* (15%) dominated followed by *C. hoplites* (12%) and *Clorridopsis immaculata* (6.6%).
- Among molluscs, *Sepia* spp. (4.8%) dominated followed by *Sepiella* spp. and *Loligo* spp.
- Low-value bycatch was sold at Rs.2/kg and estimated value of landed low-value bycatch at Visakhapatnam was Rs. 1.7 million for the 6 month period.

PROJECT CODE	**CF/IDP/03**
PROJECT TITLE	**Appraisal of marine fisheries of Maharashtra**
SCIENTISTS	**V.D.Deshmukh,** A. Kurien, M.Z. Khan, S.G. Raje, Miriam P.S., Paramita B., Somi Kuriakose, V.P. Vipinkumar and S.K. Panda (CIFT)
CENTRES	Operated from Mumbai, Cochin and Veraval

- During the year estimated marine fish landing in Maharashtra was 2.82 lakh tonnes which recorded 20% decline as compared to 3.51 lakh t in 2004.
- Almost all the important fish resources excepting for silver pomfret (+53.7%) and cephalopods (+26%) showed considerable decline in

catch; noteworthy among them were ribbonfish (-51.2%), mackerel (-49.4%), tuna (-35%), golden anchovy (-30.2%), penaeid prawns (-20.8%) and Bombay duck (-20%).

- Shrimp trawl was the major gear that contributed 64.2% followed by *dol* net (24%), gill net (7.4%), purse seine (3.2%) and others (1.2%) to the total fish catch. During the year fishing effort for all the gears declined as compared to the previous year.
- The trawling effort in the state declined by 13.4% while the fish catch declined by 29.5% registering 14.2% decline in the catch rate. Consequently the catch of demersal resources in general and penaeid prawns (39,310 t) in particular declined by 25.7%. The penaeid prawn fishery was mainly supported by *P. stylifera* (27.7%), *M. affinis* (25.4%) and *S. crassicornis* (15%).
- The catch of non-penaeid prawns as compared to 2004 declined by 61.6% in trawl (4733 t) and 5.8% in *dol* nets (32455 t). The *dol* net fishery was mainly contributed by *Acetes* spp while *Nematopalaemon tenuipes* supported the trawl fishery.
- Lobster fishery registered marginal (4%) decline in the state. The fishery supported by a single species, *Panulirus polyphagus* was mainly sustained by 2 &3 year old year classes. In the month of September the incidence of berried females was as high 61%.
- The estimated catch of elasmobranchs in trawl, gill and dol net was 4235t, 2438t and 413t, respectively which recorded 26.5% decline and 20.7% and 14.4% increase over the previous year in the same order. Sharks dominated the elasmobranchs among which *S. laticaudus* contributed 79%. In the case of rays and skates *Himantura alcockii* (52.8%) and *Rhynchobatus djiddensis* (91.6%) were the dominant species, respectively.
- The catch (2977t) and the catch rate of lizard fishes landed by trawlers showed 7.6% and 24.4% increase. *S. tumbil* and *S. undosquamis* were the only species landed. The incidence of juveniles (<280mm) in the catch was as high as 77%.
- The pomfrets exploited by trawl, gill and dol net were 1159 t, 2101 t and 3305 t, respectively. The catch declined by 36.5% in trawl but improved by 86.6% in *dol* net as compared to the last year. Entire fishery of *P. argenteus* was constituted by juveniles (< 270 mm); their occurrence was maximum in trawl (98.3%), followed by dol net (95.3%) and gill net (89.3%).
- The catch of polynemids (1656 t) decreased by 26.1% when compared to previous year. *P. heptadactylus* 83.5% and *P. indicus* 15.3% were the major species and about 35% of the catch of *P. heptadactylus* was constituted by the juveniles (< 133mm).
- The catch of Bombay duck in *dol* net at Arnala increased marginally by 2.5%. The percentage of juveniles (<240mm) in trawl and *dol* net was 46.1 and 86.3. The spawning stock biomass of the species was 27,275 t and the standing stock biomass was 59,419 t.
- Golden anchovy *Coilia dussumieri* registered decline in both trawl and *dol* net as compared to last year. The annual mean size of the

Panulirus polyphagus landed at Mumbai

fish was 152 and 118 mm in the two gears, respectively. With total mortality coefficient of 7.1 and exploitation ratio of 0.68, the stock was optimally exploited by *dol* nets at Arnala and trawl net at New Ferry wharf.

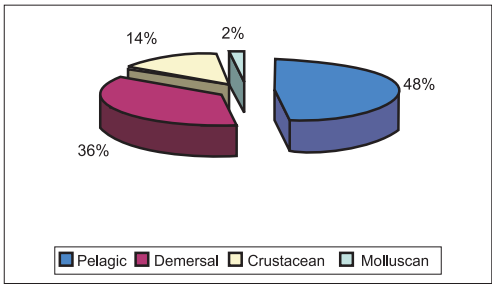
- The ribbonfish fishery by trawl suffered heavily with catches less than half of last year. The annual mean size of *T. lepturus* which constitutes the trawl fishery was 65 cm while exploitation rate was 0.73 indicating overfishing of the stock.
- The seasonal fishery for mackerel by purse seine at Sassoon dock also declined. The size range *R. kanagurta* was 155-255 with annual mean size of 227 mm.
- The croaker landings at 22,813 t declined by 23.1% when compared to previous year. The species composition observed at New Ferry wharf and Versova showed dominance of Koth *O. biauritus* (29.4%) followed by *J. vogleri* (24.8%), *J. macrorhynus* (19.1%) and *O. cuveiri* (14.2%). Size range of *O. biauritus* was 120-1400 mm with the catch mostly consisted of juveniles (99.7%). The females of Koth dominated the catch and their gonads were mostly in immature condition. Food of *J.vogleri* and *O. biauritus* showed highest preference for *Acetes* spp and *S. crassicornis* in the former and Bombay duck and *N. tenuipes* in the latter species.
- In the catch of groupers landed at NFW and Versova indicated *E. diacanthus* as the single most dominating species (89%) followed by *E. tauvina* and *E.latifasciatus* (1.5%). The annual mean size of *E. diacanthus* was 217mm and being protogynous, most of the young fishes were females. Almost 90% of the fishes landed by the trawlers were juveniles.
- In the catch of catfishes landed by trawlers *Osteogeneisus militaris* formed the bulk (35.4%) followed by *Arius dussumeiri* (30.8%), *A. caelatus* (13.8%), T. *thalasinus* (9.0%), *A. tenuispinis* (7.7%), *A.sona* (1.3%), *A.serratus*(1.2%), *A.jella* (0.6%) and *A.maculatus* (0.1%). Feeding biology of *O.militaris* showed fish and squilla. The catch of the species consisted of 69% juveniles.
- *N. mesoprion* (54.2%) dominated catch of thread fin breams followed by *N. japonicus* (23.9%) and *N. delagoae* (22%). Only 12% of *N. mesoprion* catch consisted of juveniles. The sex ratio of the species showed dominance of males (1:0.5) with maximum number of females in mature condition.

PROJECT CODE	**MF / CAP /01**
PROJECT TITLE	**Appraisal of marine fisheries of Andhra Pradesh**
SCIENTISTS	**G. Syda Rao,** M.Srinath, G.Maheswarudu, A.K.Unnithan, A.K.V.Nassar, S.Immanuel, U.R.Kumar (CIFT) R.Reghu (CIFT) and Rajeswari CIFT)
CENTRE	Visakhapatnam

Andhra Pradesh contributes 7.5 % of the total marine fish production in the country. Total estimated catch for the period January to December 2005 observed at Visakhapatnam Fisheries Harbour was 40, 089 tonnes. Small mechanized (SMB) and *Sona* boats contribute to major share of

the landings in Visakhapatnam. The pelagic fishes dominated the landings followed by demersal fishes and crustaceans from both small mechanized and *Sona* boats.

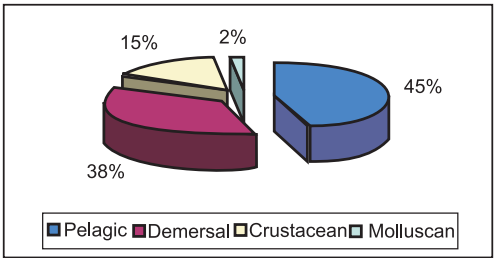
Apart from mechanized fishing, indigenous fishing also contributes a major part in and around Visakhapatnam during the year 2005. The gears used for indigenous fishing are mainly gill nets, silk nets and boat seines. The total catch estimated from indigenous fishing for the year 2005 at Lawson's Bay was 569 t. About 90% of the indigenous fish catch was pelagic fishes.



Composition of fish catch in small mecahnized trawlers

Pelagic resources

- Total mackerel catches were estimated as 3141 t during January to December 2005. *Sona* boats contributed 2005 t (64%) followed by small trawlers (28%), silk net (7%) and boat seine (1%). The catch rates were 332 kg/unit, 91.5 kg/unit, 40.1 kg/unit and 8.3 kg/unit for *Sona* boats, small trawlers, silk nets and boat seines, respectively.
- *Sardinella* spp. catches were estimated at 1325 t during the period. *Sona* boats contributed 53% of the resource followed by small trawlers (38%), gill nets (6%) and boat seine (3%), and the catch rates were 132 kg/unit, 52 kg/unit, 53 kg/unit and 19 kg/unit, respectively.
- Total landing of seer fish was estimated to be 93 t. Small-mechanized boats contributed 18.1 t with a catch rate of 5.2 kg/unit. *Sona* boats contributed 34.1 t with a catch rate of 6.6 kg/unit. Hooks and lines contributed 22.5 t with the catch rate of 1.13 kg/unit and silk nets contributed 18.15 t with a catch rate of 3 kg/unit.
- During January to December 2005, total landings of *Trichiurus lepturus* at Visakhapatnam landing center from SMB, *Sona* boats and Boat seines were estimated to be 3563 t, out of which SMB contributed 681.7 t, *Sona* boats contributed 1070 t and boat seines 29.6 t, with a catch rate of 73.2 kg/ unit, 177.18 kg/unit and 16.48 kg/unit, respectively.
- During January to December 2005, a total of 967 t of tunas were landed by indigenous gears (Hooks and lines) at Visakhapatnam Lawson's bay landing center. 551 t of yellowfin tunas, 242 t of *K. pelamis* and 174 t of *E. affinis* were reported. Yellowfin tunas contributed 31.7% of total fish catch of hooks and lines at Visakhapatnam landing center. Growth parameters of yellowfin tuna (*Thunnus albacares*) were estimated as Lα 240 cm and K 0.194. T_0 was estimated as –0.290. Length and weight may be expressed as $Y= 8E\text{-}05\ X^{2.6451}$.



Composition of fish catch in *Sona* boats

Crustacean resources

- Penaeid shrimp: The total estimated catch was 4645.6 t with a catch rate of 3.99 kg cph. Shrimp formed on an average 11.5% of total trawl landings. Of the shrimp catch landed, *Sona* boats contributed 76.4% (3551t) with 4.677 kg cph and small trawlers contributed 23.6% (1094.6 t) with a cph of 2.702 kg. The percentage of shrimp and cph of *Sona* boats were higher than that of small trawlers. June

– July, October and December were productive months for penaeid shrimp.

- Crab: The total estimated crab catch was 983.8 t with a cph 0.845 kg. Crab formed 2.4% of total landings. Of the 983.8 t, *Sona* boats contributed 41.5% (408.24 t) and small trawlers contributed 58.5% (575.57 t). The cph was higher for small trawlers (1.421 kg) than that of *Sona* boats (0.538 kg).

Demersal resources

- Nemipterids were landed by small mechanized boats with a catch rate of 2.0 kg/hr. The percentage of catch in total landings was 6.0 % where as in *Sona* boats 1304 t of nemipterids were landed with the catch rate of 1.7 kg/hr.
- During January to December 2005, small-mechanized boats landed 1069 t of goatfish with the catch rate of 2.6 kg/hr. The percentage of catch in total landings was 7.9%. In Sona boats the catch was 2394 t with the catch rate of 3.1 kg/hr. The percentage of catch in the total landing was 8.9 t.
- During the reporting period, 529 t of sciaenids were landed by small mechanized boats with the catch rate of 1.3 kg/hr. The percentage of catch in total landings was 3.9 kg. one thousand four hundred and twenty seven tonnes of sciaenids were landed with the catch rate of 1.9 kg/ hr by Sona boats and the percentage of catch in the total landing was 5.3.
- During the period, 502 t of lizardfish were landed by small mechanized boats with the catch rate of 1.2 kg/hr. The percentage of catch in total landings was 3.7. Nine hundred and eighty five tonnes of lizardfish were landed with the catch rate of 1.3 kg/hr and the percentage of catch in the total landing was 3.7.
- During January to December 2005, 238 t of pomfrets were landed by small mechanized boats with the catch rate of 0.6 kg/hr. The percentage of catch in total landings was 1.8. Five hundred and eighty one tonnes of pomfrets were caught using *Sona* boats with a catch rate of 0.8 kg/hr and the percentage of catch in the total landings was 2.2.

Molluscan resources

- The total cephalopod catch was 268 t in small-mechanized boats with the catch rate of 0.7 kg/hr. The percentage of catch in total landings was 2% whereas in *Sona* boat the total catch 430 t with catch rate of 0.6 kg/hr and the percentage of catch in the total landings was 1.6.
- The total estimated landings of bivalves and gastropods at Bhimilipatnam estuary were about 1008 t. *Meretrix casta, Meretrix meretrix, Anadara granosa* and *Crassostrea madrasensis* were the major bivalve resources. Gastropods formed only a minor component.

Relative abundance in terms of catch rate of different species in different gears

- In small mechanized boats, nemipterids composed mainly of *N. japonicus* (65%), *N. mesoprion* (14%), *N. tolu* (9%) *N. luteus* (6%) and *N. delagoae* (6%). In small-mechanized boats, the species of goat fishes were mainly *U. vittatus* (55%), *U. sulphureus* (29 %) and *U. molluccensis* (16 %).

- Among sciaenids, the species in the fishery were *Pennahia macrophthalmus* (27%), *Otolithes ruber* (22%), *Johnieops vogleri* (16%), *Johnius dussumieri* (12%), *Kathala axillaris* (6%), *Protonibea diacanthus* (5%), *Johnius amblycephalus* (4%), *Johnius carutta* (4%), *Nibea maculata* (3%) and *Crysochir aureus* (1%) in both small and *sona* trawl units. Among lizardfishes, the species present in the fishery were *Saurida undosquamis* (48 %). *S. tumbil* (40%). *S. micropectoralis* (11%) and *S. logimanus* (1%). Among pomfrets the species were *Parastromateus niger* (55%), *Pampus argenteus* (41%) and *P. chinensis* (4%) in both small and *sona* trawl boats.

- The lengths of *R. kanagurta* in trawl nets ranged from 150 to 225 mm, with modes at 180 and 205 mm. In silk nets the length ranged from 190 to 255 mm, with modes at 210 and 225 mm, and in boat seine it was 70 to 185 mm with modes at 100 and 130 mm.

- Length of *S.longiceps* ranged from 100 to 185 mm, with modes at 175, 115 and 145 mm. In *S.gibbosa*, length ranged from 130 to 170 mm with a mode at 150 mm. About 20 species of shrimps contributed to the small trawlers catch and *Metapenaeus dobsoni* (26.0%) dominated the catch followed by *M. monoceros*, *Metapenaeopsis mogiensis*, *Solenocera crassicornis* and *Metapenaeopsis barbata*. The contribution of commercial species was 21% (229.74 t) with a cph, 0.567 kg. The contribution of *M. dobsoni* and *P. stylifera* was 29.1% (318.5 t) with 0.786 kg cph. The other small size shrimp contributed 49.9% (537.4 t) of the catch with 1.326 kg cph.

- Of the *Sona* boat catch, 26.3% was landed as dried shrimp. The wet catch was dominated by *M. monoceros* (12.6%) followed by *Parapenaeopsis* spp. (11.5%), *Metapenaeus dobsoni* (11%) and *Metapenaeopsis* spp. (11.0%). Commercial species contributed 21.4% of the catch (759.9 t) with 1.0 kg cph. *M. dobsoni* contributed 11% (390.6 t) with 0.514 kg cph. The other species contributed 67.6% (2400.5 t) with a cph of 3.161 kg.

- The catch of crabs in small trawlers was constituted by *Portunus sanguinolentus* (89.9%), *P. pelagicus (*7.6%) and *Charybdis feriatus* (2.5%). Ovigerous females were present in the catch during the period. Juveniles were reported from both trawl net and boat seines. 54.7 percent and 100 percent juvenile catches were reported from trawl nets and boat seine, respectively.

Socio-economic analysis of trawl fishers

- The study area selected was the fishing harbor of Visakhapatnam

district. The total sample studied was 150 fishermen involved in small trawl fishing.

- An analysis of the age of the fishermen revealed that 40% of them belong to the age group of 31 to 40 years and 43% were illiterates. Majority (70%) belonged to Nadabalija caste and 30 % to Jalari caste. Most (85%) of them were Hindus. Nearly 41% of them had an income of Rs. 40,000 to Rs. 50,000 per annum. Regarding the literacy of women in these families, 68% of them were found to be illiterates. Majority (75%) of the children in these families were involved in fishing and only 18% of them were illiterates. A good percentage (70%) lives in tiled houses with a living area of 42 to 71 m^2. About 70% of the houses were electrified. Toilet facilities were not there in any of the houses. Nearly 60% of them possess television. None of the fishers had land of their own. The average take home income ranges between Rs.150 to Rs.250 per day. Nearly 80% of them use mobile phones and it is helping them to get more value for their product. They go for fishing for around 200 days in a year. In small trawlers, drivers were paid salary @ Rs.30 per day. Other crew (Fishing Kalasi) never gets any salary. During fishing days, driver gets Rs. 20 and crew gets Rs. 10 as bata. All of them get 10% incentive of the total value of the fish. The income from the dry fish sale goes solely to the crew including the driver. Decision making in the family is mostly done by men (61%) but the custodian of money is usually women (50%). Nearly 50 % of their leisure time is spent on recreational activities. Dowry system is prevailing in the community and the minimum amount is Rs.10,000. Only 20% had adopted family planning measures. None of the fishers have taken an insurance policy. Majority (65%) had taken loan from moneylenders at the rate of 10% interest. The major constraints reported by all of them were rise in diesel price which is ultimately affecting their incomes Nearly 67% reported that competition from other trawlers and fish price fluctuations as the other problems. The other social problems were lack of micro credit (70%), inadequate income (50%), dowry (46%) and indebtedness (40 %).

Mesh selectivity studies

- Designed and fabricated 30 m demersal trawl for whole trawl and cod end selectivity studies. Designed and fabricated 30 mm, 35 mm, 40 mm, 50 mm , 60 mm and 80 mm square mesh cod-ends. Results of 30 mm cod-end selectivity were as follows: The percentage escapement was found to be 18% of the total catch and was constituted by *Leiognathus bindus* (40-75 mm), *L. dussumieri* (45-65 mm) *Gazza minuta* (30-50 mm), *Saurida tumbil* (100-150 mm), *Stolephorus indicus* (65-120 mm), *S. commersonii* (75-100 mm), *Lepturacanthus savala* (150-280 mm), *Secutor insidiator* (50-75 mm), *Dussumieria acuta* (90-150 mm), *Upeneus vittatus* (60-160 mm), *Upeneus sulphureus* (100-160 mm) *Nemipterus japonicus* (75-98 mm), *Apogon* sp (50-75 mm), *Metapenaeus dobsoni* (35-60 mm), *Loligo duvauceli* (45-80 mm) *Opisthopterus tardoore* (90-110 mm) and *Otolithes cuvieri* (140-200 mm).

- Studies on 40 mm cod-end selectivity were conducted with 30 m

demersal trawl. The escapement was found to be 30% of the total catch. The escapement consisted of *T. lepturus* (310-450 mm), *L. bindus* (30- 50 mm) *S. tumbil* (120-250 mm), *U. vittatus* (*100-140 mm*), *U. sulphureus* (100-160 mm), *N. japonicus* (75-98 mm), *Nibea maculata* (*50-75*), *Otolithes cuvieri* (110-210 mm), *Dussumieria acuta* (130-170 mm) and *Thryssa mystax* (140-160 mm).

- Studies pm 50 mm cod-end selectivity was conducted and the escapement percentage of catch was 45.8%. The size range of escaped species was *Trichiurus lepturus* (240-500 mm), *T. mystax* (120-150 mm), *P. argenteus* (120-160 mm), *P. niger* (120-160 mm), *U. vittatus* (90-160 mm) *S. tumbil* (160-190 mm), *L. dussumieri* (40-80 mm) and *N. japonicus* (60-90 mm).
- The selectivity data was analysed for *S. tumbil* and L_{25}, L_{50} and L_{75} were calculated and found to be 18.02, 23.07 and 28.11 cm, respectively.
- Whole trawl selectivity was conducted by using 30 m demersal trawl attached with pouches made of PA netting at each panel. An escapement of 0.01 top 1% of the catch was observed consisting of *S. indicus, S. commersonii and T. mystax* and *D. acuta,* from the hind belly of the demersal trawl.

PROJECT CODE	**MF / CAP /02**
PROJECT TITLE	**Building trophic models and fisheries management simulations for the Indian Seas: Part 1 - Northwest coast (NWC) and Gulf of Mannar (GOM) ecosystems**
SCIENTISTS	**K.S. Mohamed,** M. Srinath, E. Vivekanandan, P.U. Zacharia, T.V. Sathianandan, V.D. Deshmukh, M.Z. Khan, S.G. Raje, V.V. Singh, Miriam Paul, Paramita Banerjee, K.V.S. Nair, P.K. Asokan, S. Ghosh, V. Venketasan, Bindu Sulochanan, E.M. Abdussamad, K.K. Joshi and P.S. Asha
CENTRES	Cochin, Mangalore, Mumbai, Veraval, Chennai, Mandapam and Tuticorin

Delineation of Ecological Groups

NWC Ecosystem

For the NWC ecosystem 26 ecological groups were created based on species sharing ecological niches, size and feeding modes. The groups included:

- Marine mammals (Dolphins, porpoises and whales); Sea birds; Large pelagics (*Thunnus albacares, Euthynnus affinis, Scomberomorus commerson, S. guttatus, Sphyraena obtusata, S. jello* and *Carcharhinus* spp, *Rhizopriniodon acutus*).
- Large benthic carnivores (*Otolithes biaritus, Pseudosceina diacanthus, Epinephelus diacanthus, M. talabonoides, Lethrinus* sp, *Lutjanus* sp); Rays & Skates *Dasyatis imbricatusi*; Medium benthic carnivores (*Saurida tumbil, Polynemus indicus, O. militaris, T. caelatus, Scoliodon laticaudus*); Small Benthic Carnivores (*N. mesoprion, N. japonicus, Johnius vogleri, Johnius gkaucuas, Otolithes cuvieri, Upeneous sulphureus*); Mid-water carnivores (*Megalspis cordyla, Pampus argenteus, Formio niger, S. tol, T. lepturus*).
- Bombay duck (*Harpadon nehereus*); Whale Shark (*Rhiniodon*

typus); Small pelagic herbivores (*Hilsa toli, Sardinella* sp., *Pellona* sp.; Small pelagic carnivores (*Rastrelliger kanagurta, Coilia dussumieri, Escuolosa thoracata*).

- Cephalopods (*Sepia pharaonis, S. aculeate, Loligo duvauceli, Octopus membranaceous*) ; Benthic omnivores (*Pseudorhombus* sp. and *Oratosquilla nepa*); Large reef fishes; Small reef fishes.
- Non-penaeid prawns (*Exhippolysmata ensirostris, Acetes indicus, Nematopalaemon tenuipes*); penaeid prawns (*Penaeus semisulcatus, Penaeus monodon, Metapenaeus monoceros, M. affinis, M. kutchensis, Solonocera crassicornis*); Crabs and lobsters (*Charybdis feriatus, Portunus pelagicus, P. sanguinolentus, Panulirus polyphagus*).
- Benthic epifauna (Bivalves, Gastropods, Echinoderms); Benthic infauna (Polychaetes and other benthos).
- Large zooplankton (Hydrozoan medusae, salps, alima, phyllosoma, megalopa, siphonophores, ctenophores); Small zooplankton (Copepods, mysids, crustacean larvae, fish eggs and larvae); Phytoplankton (diatoms, dinoflagellates); Marine Plants ; Detritus.

GOM Ecosystem

For the GOM ecosystem which has an area of 10,500 km^2 (including 560 km^2 national park), 32 ecological groups were created based on species sharing ecological niches, size and feeding modes. The groups included:

- Dolphins, Whales, Sea birds, Large Pelagics (*Thunnus albacares, Euthynnus affinis, Scomberomorus commerson, Sphyraena* spp.,*Caranx ignobilis, Carcharhinus* spp, *Rhizoprionodon acutus*,*Istiophorus platypterus, Rachycentron canadum, Coryphaena lysan, Mola mola, Elops saurus*).
- Medium pelagic carnivores (*Megalaspis cordyla, Scomberoides* spp, *Tetrodon* sp.); Large benthic carnivores (*Epinephelus tauvina, M. talabonoides, Lethrinus* sp, *Lutjanus* sp, *Anguilla bicolor, Lates calcarifer, Trichiurus lepturus*); Rays & Skates (*Dasyatis imbricatus, Rhinoptera javanica, Gymnura poecilura, Himantura bleekeri*); Medium benthic carnivores (*Saurida undosquamis, Arius platystomus, Scoliodon laticaudus, Chirocentrus dorab, Selar crumenophthalmus, Caranx caranx, Priacanthus spp, Pampus argenteus, Formio niger*); Small benthic carnivores (*Nemipterus* spp,, *Scolopsis* sp., *Johnius* spp., *Otolithes* spp, *Upeneus sulphureus, Sillago sihama, L.dussumieri, Gazza minuta, Secutor insidiator, L.lactarius, Gerres* spp).
- Small pelagic carnivores (*Sardinella albella, Rastrelliger kanagurta, Decapterus* spp, *Atul mate, Selaroides leptolepis, Thryssa mystax, Escualosa thoracata, Therapon jarbua*); Medium omnivorous fishes (*Mugil* spp, *Liza macrolepis, Chanos chanos, Cynoglossus* spp) ; Small pelagic herbivores (*Sardinella longiceps, Hilsa* spp, *Hemiramphus* spp, *Sardinella gibbosa*).
- Crabs and lobsters (*Portunus sanguinolentus, P. pelagicus, P. nipponensis, Charybdis* spp., *Panulirus ornatus, P.homarus, P. versicolor*); Penaeid prawns (*Penaeus semisulcatus, P. monodon, Fenneropenaeus indicus*).

- Large reef fishes (*Siganus* spp., *Sparus* spp., *Acanthurus* spp.); Small Reef Fishes (*Chaetodon* etc.); Cephalopods (Squids, cuttlefish and octopus).
- Filter feeding invertebrates (*Mactra* sp., *Pinctada fucata*); Carnivorous invertebrates (Sea urchin, *Pentaceraster* spp, *Xancus pyrum, Hemifussus pugilinus, Chicoreus ramosus, Lampis lampis, Cymatium pileare, Conus* sp., *Babylonia* sp.); Herbivorous invertebrates (*Haliotis varia, Cyprea* sp., *Nassa* sp., *Nerita* sp., *Turitella* sp.); Detritivorous invertebrates (*Holothuria scabra, H.spinifera, H.atra*).
- Benthic infauna (*Gammarus* sp., *Nereis* sp.); Large carnivorous zooplankton (medusa, salps, ctenophores, siphonophores); Small carnivorous zooplankton (Fish and crustacean larvae, copepods); Herbivorous zooplankton (copepods, mysids, crustacean larvae, fish and bivalve larvae).
- Sea Turtles (Olive ridley, hawksbill, green, leatherback, loggerhead); Dugong (*Dugong dugong*); Phytoplankton (diatoms, dinoflagellates); coral polyps; sponges; marine plants (Seaweeds, Sea grass); detritus.

ECOPATH Parameter Estimates

Diet composition : 67 species of fish

Biomass estimates : 8 species of sea grass, zooplankton and gastropods

Aspect ratio : 8 species

NWC Ecosystem

	Species	P/B Ratio
1	*Otolithoides biauritius*	1.50
2	*Johneiops vogleri*	3.20
3	*Epinephelus diacanthus*	1.50
4	*Nemipterus japonicus*	2.80
5	*N. mesoprion*	3.40
6	*Parapenaeopsis hardwickii*	0.62
7	*P. stylifera*	2.28
8	*Metapenaeopsis kutchensis*	1.28
9	*Metapenaeus monoceros*	1.68
10	*Penaeus semisulcatus*	1.75
11	*Solenocera choprai*	0.87
12	*S. crassicornis*	1.63
13	*Nematopalaemon tenuipes*	0.87
14	*Exhippolysmata ensirostris*	3.38
15	*Charybdis feriatus*	2.32
16	*Thenus orientalis*	2.10
17	*Panulirus polyphagus*	4.38
18	*Loligo duvauceli*	2.64

GOM Ecosystem

	Species	P/B Ratio
1	*Sardinella albella*	2.26
2	*S. gibbosa*	3.27
3	*Rastrelliger kanagurta*	7.12
4	*Sepia pharaonis*	5.15
5	*Sepiella inermis*	1.03
6	*L. duvauceli*	2.31
7	*Cistopus indicus*	1.46
8	*Babylonia spirata*	1.54
9	*Bursa cruemena*	0.48
10	*Xancus pyrum acuta*	2.29
11	*X. pyrum obtusa*	2.15
12	*Hemifusus pugilinus*	4.09
13	*Murex haustellium*	1.77
14	*Oliva gibbosa*	0.82
15	*Lambis lambis*	1.15

Training on Ecosystem Modeling

- Hands-on training workshop was organized at Mumbai Research Centre of CMFRI from *17-19 Nov 2005* to project associates working on the NWC ecosystem. The training included theory and practical on fisheries ecology, principles of ecosystem modelling, basic parameterization, ecological groupings, biomass and diet estimations, auto and manual mass balancing, parameter evaluation, preparation of scenarios for simulation.
- A similar training workshop was conducted for project associates working on the GOM ecosystem from *28-30 Nov 2005* at Tuticorin RC of CMFRI. A workshop kit consisting of EwE training manuals were distributed to all participants.

Sponsored Projects

FUNDING AGENCY	**Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Govt. of India**
PROJECT TITLE	**Marine fisheries census 2005**
SCIENTISTS	**Scientists of various division**
CENTRES	Cochin and All Regional and Research Centres

The All India Marine Fishermen Census- 2005 entrusted to CMFRI by DAHD&F, Ministry of Agriculture, in a project mode had commenced in the last quarter of 2004. But the major field work encompassing the collection of ground level data from two main sources viz, fishing villages *per se* and the records pertaining to landing facilities was undertaken simultaneously from all the coastal states and mainland UTs, except Tamilnadu and Pondichery and Karaikal parts of Pondichery UT, between 15th April 2005 and 15th May 2005. Destined to be the feeder of vital ground level information to the planners, this Census data was designed to be collected in two sets of schedules, the first a purely first hand one collected by temporarily engaged enumerators from fishing villages and the second a mixture of primary and secondary information populated by the Institute's survey staff. As the whole exercise was time bound and labour intensive, a three-tier supervision mechanism was set in place. The data collected from the first round of Census has since been ordered, scrubbed and entered into a vibrant database format with full scalability. Customised tables and query based reports were used for cross-checking the data with their nearest published estimates/ figures. The following table represents the volume of information processed:

State	Villages	Households	Population	File size(KB)
WB	353	53816	269565	101832
OR	641	86352	450391	148508
AP	500	129246	509991	168736
KER	222	120486	602234	195136
KAR	156	30176	170914	53852
MH	406	65313	319397	100472
GOA	39	1963	10668	8196
GUJ	263	59889	323215	93024
Total	**2580**	**547241**	**2656375**	**869756**

The information collected was objective with all major facets of craft and gear trivia including HP range, length of craft, type of material with which the gear was made etc. included in the design. Probably for the first time, efforts have been made to record the crafts/ gears co-owned by more than one family, a factor, which has been plaguing the previous attempts to get such information. The following gives a glimpse of the sector-wise resource spectrum among the states covered.

Percentage of crafts fully owned by fishermen based at the fishing villages (not a landing center based figure)

State	Mechanised	Motorised	Traditional
West Bengal	34.76	8.87	56.36
Orissa	11.49	20.21	68.30
Andhra Pradesh	1.78	30.36	67.86
Kerala	7.17	44.00	48.83
Karnataka	18.89	10.15	70.96
Goa	21.25	17.56	36.56
Maharashtra	45.88	17.56	36.56
Gujarat	52.14	29.96	17.90

Provisional array of ownership pattern vis-à-vis crafts

State	Fully owned	Shared (estimated)
West Bengal	17669 (98.84)	207 (1.16)
Orissa	21110 (92.04)	1826 (7.96)
Andhra Pradesh	29604 (84.00)	5638 (16.00)
Kerala	19173 (90.61)	1986 (9.39)
Karnataka	10622 (83.10)	2160 (16.90)
Goa	1831 (98.63)	25 (1.37)
Maharashtra	19141 (98.42)	308 (1.58)
Gujarat	14666 (99.03)	143 (0.97)

(*figures in parentheses indicate percentage*)

A detailed report is being prepared analyzing each maritime state with respect to the occupational and educational status of the fishing community along with their resource profile. As regards the second phase of the Census covering Tamilnadu and Pondicherry and Karaikal areas of UT of Pondicherry, the field level data collection was completed in January, 2006 and the data compilation is in progress.

FUNDING AGENCY **Dept. of Ocean Development, Govt. of India**
PROJECT TITLE **Predictive modeling in marine fisheries of south west coast of India**
SCIENTISTS **M. Srinath,** T.V. Sathianandan and Somy Kuriakose
CENTRE Cochin

The project focuses on development of suitable univariate and multivariate predictive models for the marine fishery resources of southwest coast of India and estimate the inter relationship between the exploited stocks, the climatic and oceanographic parameters based on a cross correlation analysis. Time series of marine fish landings of southwest coast of India during 1961 to 2004 was examined by Markov chain model. A four state Markov chain model is applied to study the changes in the landings of south-west coast of India. The four states of the model is identified based on the quartiles of the time series distribution of the exploited marine fish landings of south west coast of India. The four states of the model are given by <Q1, Q1-Q2, Q2-Q3 and > Q3 where Q1, Q2 and Q3 are the quartiles. The transition probability matrices were derived from the data series and were used for the estimation of steady state probabilities.

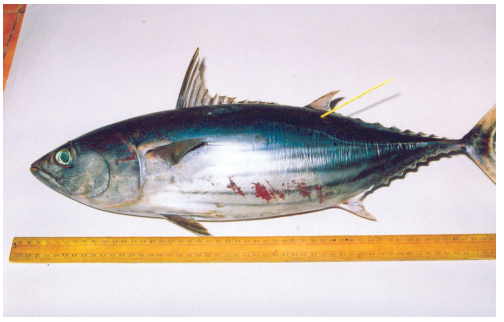
The steady state probabilities are used to forecast the landings of some of the commercially important species like oil sardine, mackerel, penaeid prawns and cephalopods. The projection indicates that there will be decline in the landings in the long run, if the present mode of exploitation is continued except in case of mackerel.

Predicted values of catch for four commercally important group.

Resource	Projected landings	Year	Landings in 2005
Oil sardine	1,75,319	2020	2,97,167
Mackerel	1,05,080	2020	76,798
Penaeid prawns	52,840	2015	54,319
Cephalopods	14,042	2035	38,449

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Tuna resources of the Indian EEZ – an assessment of growth and migratory patterns (Collaboration with FSI)-as Co-investigator**
SCIENTISTS	**N.G.K.Pillai** and K.P. Said Koya
CENTRES	Cochin and Minicoy

- At Minicoy and Agatti baseline survey was initiated on fishing activities and monitoring of the fishery and biology of skipjack and yellowfin tuna at respective islands.
- SRF based at Agatti participated in the IOTC sponsored tuna-tagging programme conducted by FSI at Suheli during February 2006. A total of 1500 tunas caught by pole and line successfully tagged and released.
- DNA was extracted from *Katsuwonus pelamis* and *Thunnus albacares* landed at Cochin Fisheries harbour, caught from Lakshadweep waters (Minicoy and Agatti) and also from International waters (lat 22Ú and long 68Ú)



Tagged skipjack tuna recovered from Minicoy

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Stock assessment and biology of deep-sea fishes in the continental slope of EEZ (Collaboration with FSI, Mumbai)**
SCIENTISTS	**A.A.Jayaprakash**
CENTRE	Cochin

Details of FORV *Sagar Sampada* cruise No.241

The cruise that spanned for a period of 18 days has covered 36 stations during 22 January to 9 February 2006. The general details of the cruise are as given below:

Days out at sea	22.01.2006 to 09.02.2006 (19 Days)
Number of fishing days	18 Days
Actual fishing effort	33.58 hrs.
Total catch	1793.7 kg.
Gear used	EXPO model trawl, HSDT-CV model trawl
CPUE	53.4Kg/hr

Details of different transects covered during the cruise

Transect	No. of hauls	Area		Depth (m)
		From	To	
9°-10°	5	Karunagappally	Kochi	115-596
10°-11°	5	Kochi	Beypore	432-781
11°-12°	5	Beypore	Ezhimala (Azhikkal)	168-691
12°-13°	7	Ezhimala (Azhikkal)	Mangalore	229-1070
13°-14°	4	Mangalore	Bhatkal	177-905
14°-15°	5	Bhatkal	Karwar	268-692
15°-16°	4	Karwar	Goa	269-844

Sorting the trawl catch onboard *FORV Sagar Sampada*

Catch composition

The catches for the entire cruise were dominated by *Psenopsis cyanea* (8.58%) followed by *Lamprogrammus exutus* (7.70%) and *Bembrops caudimacula* (7.18%). In gear-wise dominance it was seen that for EXPO model trawl the catches were dominated by *Lamprogrammus exutus* (18.36%), followed by *Saurenchelys taeniola* (10.92%) and *Neoharriota pinnata* (7.45%) and for HSDT-CV model trawl the catches were dominated by *Psenopsis cyanea* (14.30%), followed by *Bembrops caudimacula* (12.28%) and *Charybdis smithi* (10.15%).

Length frequency studies

A total of 47 species were analysed for length frequency studies during the entire cruise. The maximum specimens analysed were that of *Lamprogrammus exutus* followed by *Saurenchelys taeniola* and *Eridacnis radcliffei*. The length-weight relationship of 20 species have been worked out.

Length - Weight studies

A total of 47 species were analysed for length - weight studies during the entire cruise. The maximum specimens analysed were that of *Lamprogrammus exutus* followed by *Saurenchelys taeniola* and *Eridacnis radcliffei*.

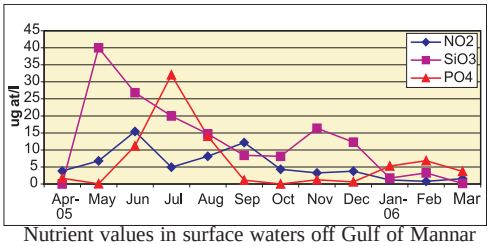
Biological studies

Maturity stages of 47 species were analysed during this cruise. In most of the species, females dominated the catch and most of them were in advanced stages of maturity. Food and feeding analysis were conducted in 47 species during the cruise. Shrimps dominated in the gut contents followed by squids and fishes.

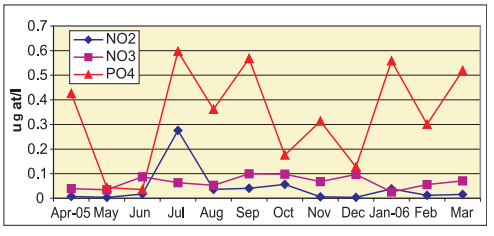
Marine Environment

PROJECT CODE	**FEM/01**
PROJECT TITLE	**Monitoring the environmental characteristics of the inshore waters in relation to fisheries**
SCIENTISTS	**V. Chandrika,** C.P. Gopinathan, P.K. Krishnakumar V.V. Singh, P.S. Asha, Bindu Sulochanan and K. Vijayakumaran
CENTRES	Cochin, Mangalore, Mumbai, Mandapam, Tuticorin and Visakhapatnam

- The sea surface temperature (SST) varied between 23.5 and 33.5ºC in the east coast and the highest was recorded at Tuticorin. Highest temperature recorded at Mandapam was 33.5ºC, 32ºC and 32ºC during April, May, and June 2005, respectively.
- Salinity ranged between 21.4 ppt and 33.4 ppt with an average of 30.2 ppt showing a significant decline in the annual average at Visakhapatnam. On an average, Mandapam and Tuticorin recorded 33.33 ppt and 34.65 ppt, respectively. The highest salinity was recorded at Tuticorin, the value being 37.4 ppt. The warmer low salinity zone enabled the east coast to effect the temperature change faster and even small changes in SST may influence the rainfall.
- Dissolved oxygen ranged between 3.5 and 8.8 ml/l^{-1} with an average of 7.1 ml/l^{-1}, the lowest value was recorded in February 2005 in the east coast and post-monsoon months recorded highest dissolved oxygen in the west coast.
- Phosphates and nitrates in surface waters ranged between 0.0134 and 0.5055 mgl^{-1} and 0.0176 to 0.3012 mgl^{-1}, respectively. An increase in marine phytoplankton was recorded due to increase in salinity along the east coast. High salinity triggered phytoplankton bloom causing eutrophication, the reason for high silicate content of 180.4µg at/l and 3.2416 mg l^{-1} at Mandapam and Visakhapatnam, respectively.
- Among the plant pigments, chlorophyll *a* ranged between 0 and 4.2668 mg m^{-3} and chlorophyll *b* ranged between 0 and 4.2668 mg m^{-3}. However, chlorophyll *c* 2.2216 mg m^{-3} was recorded only in the east coast. In the west coast, highest chlorophyll *a* was recorded at 20m depth during April 2005 especially at Cochin, the value being1.547 mg m^{-3}. In the east coast, carotenoids varied between 0 and 0.4346 m $SPUM^{-3}$ with an average of 0.049 m $SPUM^{-3}$. Phaeophytin varied from 0 to 3.5404 mg m^{-3} with an average of 0.493 mg m^{-3}.



Nutrient values in surface waters off Gulf of Mannar



Nutrient values in surface waters off Visakhapatnam

PROJECT CODE	**FEM/02**
PROJECT TITLE	**Monitoring environmental contaminants from coastal waters with reference to bioaccumulation and biomagnification in fishes**
SCIENTISTS	**P.K. Krishnakumar,** George. J.P., P. Kaladharan, D. Prema, V.V. Singh, K. Vijayakumaran, P.S. Asha and Bindu Sulochanan
CENTRES	Mangalore, Cochin, Mumbai, Tuticorin, Mandapam Camp and Visakhapatnam

The main objective of the project is to assess the environmental impact of effluent discharge from anthropogenic activities along the coastal waters of India and to monitor levels of heavy metals and its bioaccumulation in biota along the coastal waters of India.

- The biomagnification factor for Cd in organisms from the higher trophic levels (fishes and dolphins) was found to be very high. Cadmium was having the highest Bioconcentration Factor (BCF) of 1,500 followed by Cu (500), Zn (130) and Ni (120).
- Concentrations of nickel and cadmium in seawater, sediment and fish samples collected from industrialized areas of Mumbai (Mahim Creek), Cochin (Edayar River System), Karwar and Veraval were high when compared to the samples collected from relatively cleaner areas.

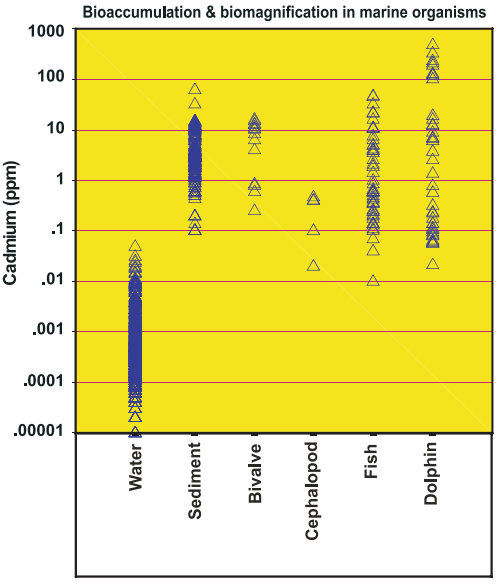
Mean concentration of nickel and cadmium in water, sediment and fish samples from different centres

Matrix	**Water** (ppb)		**Sediment** (ppm)		**Fish** (ppm)	
Metal	**Cd**	**Ni**	**Cd**	**Ni**	**Cd**	**Ni**
Mumbai	2.28	11.14	2.02	38.61	7.00	10.50
Veraval	1.54	6.44	2.04	16.16	4.72	bdl
Karwar	1.56	7.05	6.11	14.46	0.30	bdl
Mangalore	0.65	2.67	0.44	13.57	0.39	bdl
Cochin	1.58	2.23	3.09	14.09	0.00	0.46
Mandapam	0.37	6.83	0.66	7.61	1.03	1.37
Tuticorin	0.64	3.97	0.18	0.96	7.99	3.39
Chennai	1.53	5.81	-	-	-	-
Vizag	0.18	2.14	-	-	-	-
Safe limit	2.5	5	1.2	21	9	9

- Mean nickel concentrations in seawater samples from Mumbai showed highest values (11.14 ppb), followed by Karwar (7.1 ppb), Mandapam (6.8 ppb), Veraval (6.4 ppb), Chennai (5.8 ppb), Tuticorin (3.9 ppb), Mangalore (2.7 ppb), Cochin (2.2 ppb) and Vishakhapatnam (2.14 ppb). Mean cadmium concentrations in seawater samples from Mumbai also showed highest values (2.76 ppb), followed by Cochin (1.58 ppb), Karwar (1.56 ppb), Veraval (1.54 ppb) and Chennai (1.53 ppb). Cadmium and nickel concentrations in seawater samples collected from industrialized areas of Mumbai, Cochin, Karwar and Veraval were above the permissible limits.
- Similarly, mean nickel concentrations in sediment samples from Mumbai showed highest values (38.6 ppm), followed by Veraval

(16.2 ppm), Karwar (14.5 ppm) and Cochin (14.1 ppm). Mean cadmium concentrations in sediment samples from Karwar showed highest values (6.1 ppm), followed by Cochin (3.1 ppm), Veraval (2.04 ppm) and Mumbai (2 ppm). Metal concentrations in sediment samples collected from industrialized areas of Mumbai, Cochin, Karwar and Veraval were above the Effect Range Low (ERL) concentration given by NOAA.

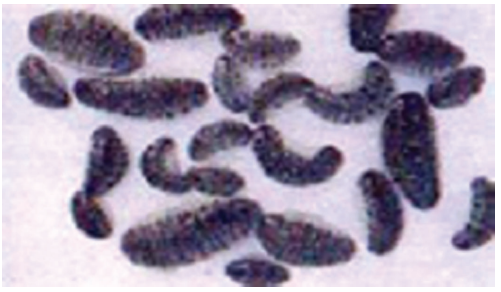
- Mean nickel concentrations in fish samples from Mumbai showed highest values (10.5 ppm), followed by Tuticorin (3.9 ppm), Mandapam (1.4 ppm) and Cochin (0.46 ppm). Mean cadmium concentrations in fish samples from Tuticorin showed highest values (7.9 ppm), followed by Mumbai (7 ppm), Veraval (4.7 ppm) and Mandapam (1 ppm). Generally, Cd and Ni concentrations in fish samples collected from the costal waters of India were with in the safe limits, except a few samples from the highly industrialized areas of Mumbai and Veraval.
- Along the 300 km coastline of Karnataka State, concentrations of Cd in seawater varied from 0.04 to 0.42 ppb, Cu varied from 0.81 to 14.8 ppb Pb varied from 0.19 to 11.7 ppb and Zn varied from 4.4 to 248.3 ppb. Metal levels in seawater were found to be with in the safe limits.



Bioaccumulation and biomagnification pattern of cadmium in water, sediments and marine organisms from the coastal waters of India

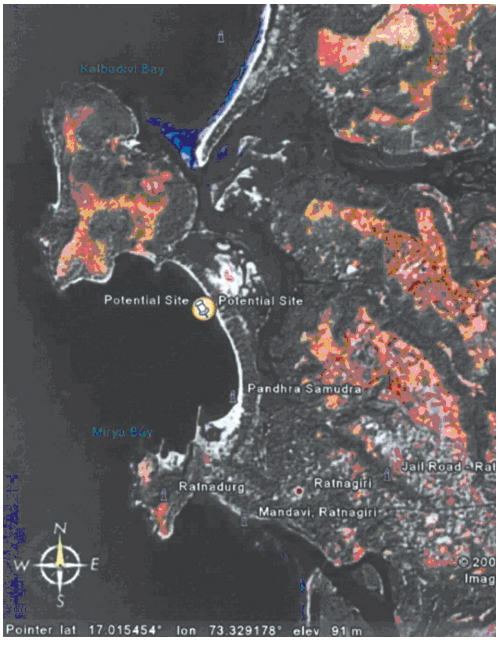
PROJECT CODE	**FEM/04**
PROJECT TITLE	**Development of strategies for sea turtle and seacucumber conservation**
SCIENTISTS	**M. Rajagopalan,** K. Vijayakumaran and P.S. Asha
CENTRES	Cochin, Visakhapatnam and Tuticorin

- The monitoring of the phenomena of the mass nesting of Olive ridley *Lepidochelys olivacea* along the Orissa coast revealed the nesting of 3.2 lakhs of Olive ridley during 2005 in February when compared to the nesting of 2.7 lakhs during 2004 season. Four thousand Olive ridley were washed ashore during the 2005 season along the Orissa coast due to mortality in fishing gear.
- Juveniles of *Holothuria scabra* measuring 5-10 mm length are more often susceptible to disease like skin lesion that led to mortality, whereas juveniles of >10 mm are comparatively resistant to such diseases. Juveniles reared in sand bed fed with *Sargassum* sp. registered higher growth rate than those reared in bare tank.
- Egg suspension from eviscerated female H. *scabra* was found to be an effective spawning inducing agent.
- Freshly added *Algamac* was found more suitable for metamorphosis and settlement than preconditioned settlers exposed to *Algamac*. Just freshly metamorphosed doliolaria had better settlement rate than 2 or 3 days old ones. An inverse relationship exists between stocking density and hatching rate of the fertilized eggs. The maximum hatching rate at 0.5 eggs/ml and at salinity 35 ppt indicated the optimum hatching condition.
- Highest survival, growth rate and fastest development of auricularia of *H.scabra* were obtained at a stocking density of 1/ml and between 33-35 ppt salinity.



Juveniles of *Holothuria scabra*

PROJECT CODE	**FEM/07**
PROJECT TITLE	**GIS based atlas on potential mariculture sites along the Indian coast**
SCIENTISTS	**V.V. Singh,** S. Jasmine, P.K. Krishnakumar, Gulshad Mohammed, Reeta Jayasankar, P.S. Asha, Bindu Sulochanan, Rani Mary George and K. Vijayakumaran
CENTRES	Mumbai, Karwar, Mangalore, Calicut, Cochin, Tuticorin, Mandapam, Chennai and Visakhapatnam



GIS Map of Ratnagiri showing potential mariculture sites

- Along the Maharashtra coast, three most potential mariculture sites were identified at Jake Miriya, Sakher-Thar near Ratnagiri town and at Musa Kazi in the Ratnagiri district. Along the south Karnataka three potential sites were identified.

Details of the suitable locations along the south Karnataka Coast:

District	Location	Position	Available area
Udupi	Byndoore	From 13° 50' N, 74°36'E 13° 52' N, 74°.34'E	~ 5 km
Udupi	North of Mulki	From 13° 19' N, 74° 4'E 13° 12' N, 74° 76'E	~ 8 km
Dakshina Kannada	South of Mangalore	From 12° 82' N, 74° 3'E 12° 78' N, 74° 85'E	~ 5 km

- In north Kerala after an initial selection of seventeen sites, seven main sites were shortlisted while in south Kerala six stations south of Cochin and five stations north of Cochin were selected. Regular sampling was done for data collection.
- In south Tamilnadu mariculture sites were selected from Point Calimer in Palk Bay to Vallinokam in Gulf of Mannar while in north Tamilnadu 6 sites were shortlisted and attributes were collected. In Andhra Pradesh survey was carried out in Kakinada Bay and area was recommended for cage-based aquaculture.
- All sites were short-listed after data on infrastructure facilities for mariculture activities and on environmental parameters such as temperature, salinity, pH, nutrients, chlorophyll etc. were collected and compared with the normal permissible limits.

Sponsored Projects

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Studies on marine mammals of Indian EEZ and the contiguous seas**
SCIENTISTS	**M. Rajagopalan,** E. Vivekanandan, P.K. Krishnakumar,P. Jayasankar and K.P. Said Koya
CENTRE	Cochin, Mangalore, Mandapam Camp,Visakhapatnam and Minicoy

- During 2005-2006, 255 days were spent on board FORV *Sagar Sampada* and made 118 sightings of mammals from Bay of Bengal and Arabian Sea (Cruise numbers 233 – 243).

Sightings of Cetaceans on board FORV *Sagar Sampada*

Cruise No.	Period	No. of sightings	Area of observations
233	15.4.05 to 24.4.05	6	South west coast of India
234	6.5.05 to 20.5.05	10	South west coast of India
235	26.5.05 to 23.6.05	9	West coast of India
236	3.7.05 to 30.7.05	12	East coast of India
237	11.8.05 to 12.9.05	9	North west coast of India
238	22.9.05 to 10.10.05	11	South west coast of India
239	20.10.05 to 13.11.05	21	Off Andaman & Nicobar Islands
240	25.11.05 to 9.1.06	20	East coast of India
241	22.1.06 to 9.2.06	13	South west coast of India
242	21.2.06 to 10.3.06	1	South west coast of India
243	24.3.06 to 12.4.06	16	Off Andaman & Nicobar Islands

- During 2005-2006, collected data on the stranding of cetaceans from Karnataka and Tamil Nadu coast.
- Stranding of three baleen whales *Balaenoptera* spp at Murudeswar, Padukere, Karnataka and Rameswaram, Tamil Nadu was reported.

Stranded *Balaenoptera* sp. on the Murudeswar beach, Karnataka

- Morphometric measurements of 15 dolphins landed during November 2005-February 2006 at Gangoli, Malpe and Mangalore were taken. Gut analysis of stranded dolphins were carried out and the dolphins examined were mainly from gill netters and purse-seiners as by-catch.
- Tissue concentrations of toxic trace elements and organochlorine pesticides in *Stenella longirostris* (long-snouted spinner dolphin) collected from Mangalore, Chennai, Cochin, Vizhinjam and Vishakhapatnam were estimated. The average organochlorine pesticide concentration observed in the blubber from Chennai was 585 ppb, while from Mangalore it was 332 ppb and from Vishakhapatanam 243 ppb. Spinner dolphins from Chennai showed high concentration for most of the metals including Zn, Cd, Cu, Se, Ni, As, Fe, Cr and Ag. V, Co and Mn were high at Vishakapatanam, while Pb was found to be slightly high at Mangalore.

Stranded *Balaenoptera* sp. on the Rameswaram beach, Tamilnadu

Bycatch of dolphins at Gangoli (above), Malpe (below)

- High concentrations of Zn, Cd, Cu, Hg, Se and Pb were observed in the liver samples of spinner dolphins. Iron was found to be high both in liver and muscle while Cd was found high in kidney. Ni, Cr and Ag were found to be low in all the organs. Almost all metals showed a trend of Liver>Kidney>Muscle at all places except for Cadmium (Kidney>Liver> muscle).
- Tissue samples from an additional 15 Cetaceans were collected during 2005-06 including 3 specimens of Indo pacific humpbacked dolphin (*Sousa chinensis*) and 12 finless porpoise (*Neophocaena phocaenoides*) from Mangalore, Malpe and Gangolli. Sex ratio was 9 males to 6 females. Genomic DNA was extracted and amplified using specific primers for the cytochome b and control region of mt DNA. Total number of accessions in the cetacean DNA bank is now 46.

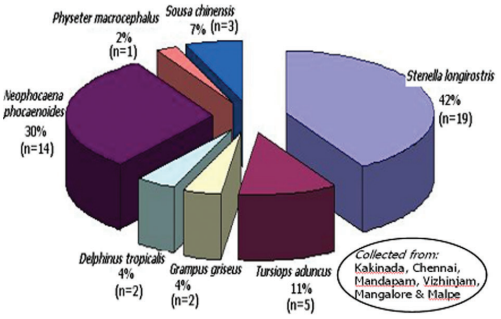
DNA sequences of marine mammals deposited in GenBank

- During the reporting year, a total of 20 PCR products (cytochrome b and control region of mt DNA) from 10 individuals of 7 species were cycle sequenced using ABI AmpliTaq FS dye terminator cycle sequencing chemistry, aligned using ClustalW Multiple alignment (*Bioedit*) and deposited in the GenBank (NCBI).

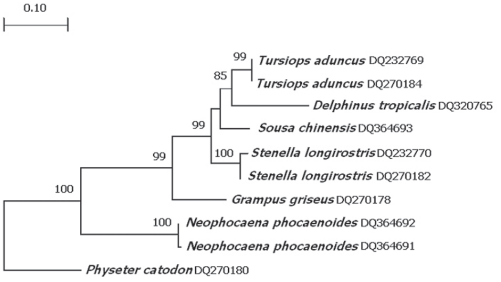
Particulars of molecular characterization of seven cetacean species including their GenBank accessions *(http://www.ncbi.nlm.nih.gov/)*

Sl. No.	Species	Sex	Place of collection & Code number	Fragment size of mt DNA (bp)	Accession number in GenBank (NCBI)
1	*Tursiops aduncus* (Bottlenose dolphin)	Female	Vizhinjam; VIZ1	417 (cytb) 204 (cytb)	DQ232769 DQ232771
2	*Stenella longirostris* (Pantropical spinner dolphin)	Female	Chennai: CH07	417 (cytb) 200 (cytb)	DQ232770 DQ232772
3	*Grampus griseus* (Risso's dolphin)	Female	Chennai; CH15	396 (cytb) 197 (cytb)	DQ270178 DQ270179
4	*Physeter macrocephalus* (Sperm whale)	—	Chennai; CHW1	403 (cytb) 172 (cytb)	DQ270180 DQ270181
5	*Stenella longirostris* (Pantropical spinner dolphin)	Male	Kakinada; VRC/DOL/05	402 (cytb) 221 (cytb)	DQ270182 DQ270183
6	*Tursiops aduncus* (Bottlenose dolphin)	Male	Chennai; CH04	400 (cytb) 210 (cytb)	DQ270184 DQ270185
7	*Delphinus tropicalis* (Delphinus tropicalis)	Female	Kakinada; VRC/DOL/03	380 (cytb) 211 (cytb)	DQ320765 DQ320766
8	*Sousa chinensis* (Indopacific Humpbacked Dolphin)	Male	Mangalore Mng4	424 (cytb) 286 (Control)	DQ364689 DQ364693
9	*Neophocaena phocaenoides* (Finless porpoise)	Female	Mangalore MNG7	426 (cytb) 270 (Control)	DQ364692 DQ364690
10	*Neophocaena phocaenoides* (Finless porpoise)	Male	Mangalore MNG8	426 (cytb) 286 (Control)	DQ364691 DQ364694

- These specimens were obtained as accidental gill net catch or as beach-cast. The generated sequences were tested for species identity by aligning with available sequences in the portals WITNESS FOR WHALES (*DNA Surveillance*) and BLAST. The bottlenose dolphin, which was earlier identified as *T. truncatus* based on morphological features, was unambiguously identified as *T. aduncus*.
- The common dolphin from Indian seas has always been identified as *Delphinus delphis*. In the present study the sequence generated from a specimen from the Bay of Bengal had 100% identity with *Delphinus tropicalis*. The present sequences had 97-100% identity with those of the corresponding species from the reference portals.
- Others, including *Stenella longirostris*, *Grampus griseus*, *Physeter macrocephalus*, *Sousa chinensis* and *Neophocaena phocaenoides* were all unambiguously identified based on phylogenetic reconstruction. Software such as Mega, Phylip and PAUP were used to delineate phylogenetic relationship among the different species of cetaceans.
- The important outcome of this work is that through this project, the institute has developed capability to identify all these seven species from their tissue, such as skin, muscle or liver without the need to actually observe the whole specimen.



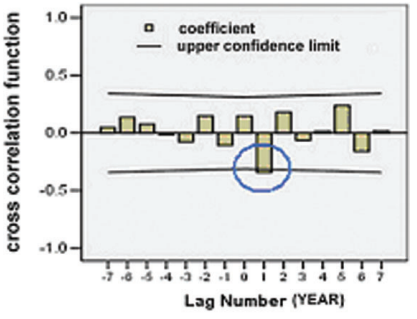
Composition of species in the Cetacean genomic DNA repository of CMFRI as on 31st March 2006



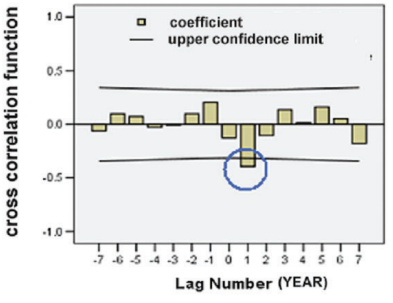
Phylogenetic relationship of 7 Cetacean species based on mt DNA cytochrome b sequences

FUNDING AGENCY **ICAR (National Network Project of NRM Division)**
PROJECT TITLE **Impact, adaptation and vulnerability of Indian fisheries to climate change**
SCIENTISTS **M. Rajagopalan,** E. Vivekanandan, N.G.K. Pillai, M. Srinath, Rani Mary George, P.K. Krishnakumar, P. Kaladharan, Reeta Jayasankar and K. Vijayakumaran
CENTRE Cochin, Mangalore, Chennai and Visakhapatnam

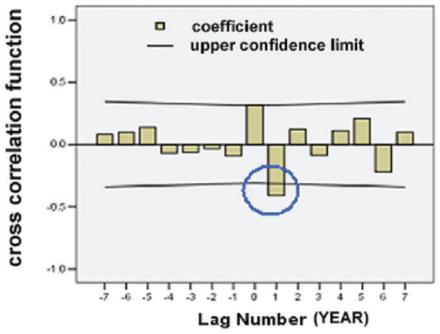
- The cruise data available from registers was digitized from 1957 to 1995 for the parameters viz. temperature, salinity, oxygen, phosphate, nitrate and pH recorded at different depths at various locations and time periods.
- Digitization of secondary data on marine fish landings of different species for the time period 1960-2004 was completed.
- Southern Oscillation Index had a negative influence on Sea Surface Temperature along the northeast, southeast and northwest coasts of India.
- Trend of the sea surface temperature during the period 1960-2002 along the maritime states shows a significant increase.
- Trend analysis of the impact of sea surface temperature on marine fish landings for the period 1960-2002 has been done for the four regions viz., southwest, southeast, northwest and northeast coast of India on macro level for five different fish groups namely pelagic, demersal, crustacean, cephalopod and total marine fish landings.
- Sea surface temperature showed a negative correlation in northeast coast with total landings, demersal, cephalopod and crustacean landings resulting in low catch in the succeeding year with increase in current year SST.



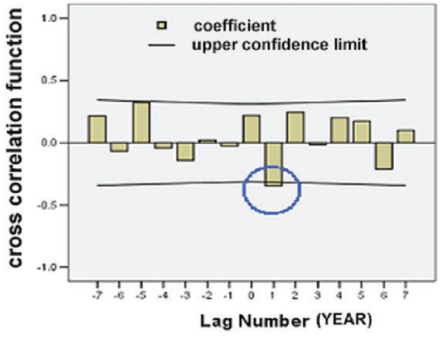
Relationship between SST and total catch along northeast coast



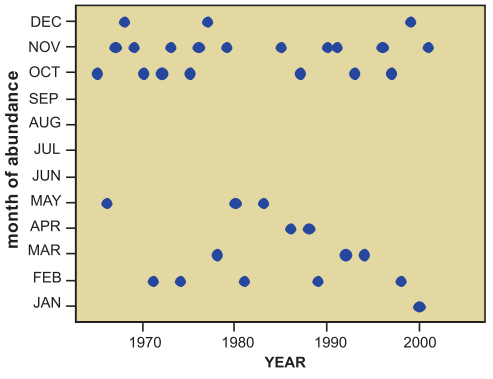
Relationship between SST and demersal catch along northeast coast



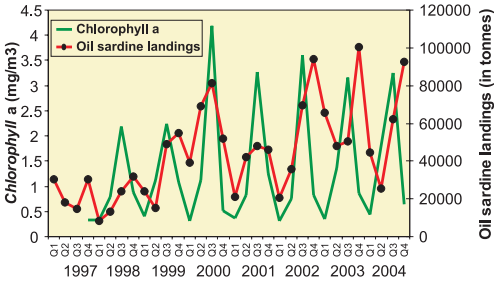
Relationship between SST and crustacean catch along northeast coast



Relationship between SST and cephalopod catch along northeast coast



Shift in peak abundacne of fish eggs & larvae



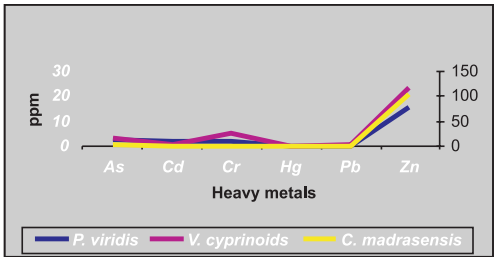
Chlorophyll a and oil sardine landings for Kerala coast (1997-2004)

- Sea surface temperature was found to have a positive correlation with southwest pelagic and total landings resulting in high catch in the succeeding year with increase in current year SST.
- Southeast total landings showed a positive correlation with increase in sea surface temperature.
- Database on coral bleaching events was generated based on published literature and classification made based on bleaching effect as low, medium and high.
- Perusal of literature showed that bleaching alerts/events can be better studied based on satellite coral bleaching monitoring products like Hotspots (which highlight SST anomalies that are one degree greater than the SST maximum monthly climatology) and Degree Heating Weeks (accumulation of thermal stress that coral reefs have experienced over the past 12 weeks).
- In India coral bleaching events reported in 1998 and 2002 was found to coincide exactly with the coral bleaching monitoring products Hotspots and Degree Heating Weeks, 1998 being high and 2002 being medium.
- Analysis based on available data showed clearly the extent of coral bleaching severity (whether high, medium, low) depends on the length of time it suffers due to increase in water temperature from normal maximum temperature.
- Sea surface temperature trend (1901-2002) also showed significant warming of ocean surface off Mangalore coast.
- Mangalore coast revealed the shift of peak abundance of copepods and fish eggs and larvae towards the earlier parts of the year indicating phonological changes.
- Another zooplankton group Cladocera showed shift in abundance towards the latter part of the year.
- Peak spawning periods of oil sardine and mackerel shifted towards the earlier parts of the year.
- The shift in abundance of fish eggs and larvae was found to be coinciding with the shift in the peak spawning periods of fishes.
- Studies off Mangalore showed that atmospheric temperature having a significant positive correlation with sea surface temperature, abundance of fish eggs & larvae and copepods, whereas it showed a negative correlation with rainfall.
- Relationships between the environmental parameters viz. wind speed and direction, and sea surface temperature with marine fish landings of oil sardine and mackerel was studied for the period 1994-2004 along the Kerala coast.
- *Chlorophyll* a concentration had a positive correlation with upwelling index and wind stress. Cross correlation between *Chlorophyll* a concentration and oil sardine landings along Kerala coast during 1997-2004 was found to be positive.

FUNDING AGENCY	**ICAR-AP Cess Fund**
PROJECT TITLE	**National risk assessment programme for fish and fish products for domestic and international markets**
SCIENTISTS	**D. Prema** and N. K. Sanil
CENTRE	Cochin
COLLABORATIVE INSTITUTE	CIFT, Cochin

During 2005 – 2006, samples of green mussel (*Perna viridis*), black clam (*Villorita cyprinoids*) and edible oyster (*Crassostrea madrasensis*) were collected on monthly intervals from northern, central and southern Kerala. The bivalve samples were processed and analysed for heavy metals and for pesticides. The processed samples were sent to CIFT, Kochi for quantification using GC. Every month, 25 numbers of live bivalves from the three zones of Kerala were examined for parasites.

- In bivalve samples the concentration of heavy metals was as follows: As (1.66ppm- 3.9ppm), Cd (ND- 2.26ppm), Cr (0.75ppm- 8.73ppm), Hg (ND- 0.13ppm), Pb ND- 1.21ppm) and Zn (9.9ppm- 116.89ppm).
- The bivalves examined during this period were free from the parasites of any sanitary significance.
- Parasites of phytosanitary significance recovered included ciliates, of the genus *Trichodina* sp. and *Stegotricha* sp., different types of nematodes, trematode metacercaria, pea crab and different species of copepods.
- The shell boring polychaete worm, *Polydora* sp. was recovered from edible oysters.
- "Bibliography: Diseases, Parasites and Toxicology of *Perna viridis*, *Crassostrea madrasensis* and *Villorita cyprinoids* (Mollusca : Pelecypoda) of India" was compiled and published as CMFRI Special Publication, No. 88.



Heavy metal load in various bivalves

FUNDING AGENCY	**ICAR-AP Cess Fund**
PROJECT TITLE	**Cattle feed Production from Selected Seaweeds of Indian Coasts**
SCIENTISTS	**P.Kaladharan,** S.N. Rai and Dinabandhu Sahoo
CENTRE	Kochi, Karnal and Delhi
COLLABORATIVE INSTITUTE	NDRI and Delhi University

- 2.2 quintals of dry *Sargassum* sp. packed in gunny bags were sent to NDRI., Karnal in four batches for feed trial.
- Seaweeds exploited by scrapping the base impairs regeneration of the crop to 32% than harvesting by cutting the fronds leaving the base.
- Profiling of six species of seaweeds for fatty acids and aminoacids revealed *Sargassum wightii* to contain maximum of aminoacids such as Cystine (3.27%) and Isoleucine (6.65%); *Ulva lactuca* to contain Serine (7.02%), Glycine (11.7 %) and Alanine (12.19%); *Gracilaria corticata* to contain Proline (6.68%), valine (6.9%) and Leucine (7.99%); *Acanthophora spicifera* to contain Glutamic acid (9.54 %), Histidine (3.58%),Tyrosine (7.48%), Methionine (3.41%) Phenylalanine (6.47 %) and Lysine (9.58%); *Hypnea valentiae* to contain Threonine (6.01 %) and Lysine (10.5 %) and the *Kappahycus alverezii* to contain a maximum of Asperagine (9.69 %) and Argenine (5.79 %).


Sargassum sp. collected from wild being landed at Mandapam

Socio-economics and Extension

PROJECT CODE	**SEE / ECO/ 01**
PROJECT TITLE	**Economics of marine fishing operations**
SCIENTISTS	**R.Narayanakumar** and R.Sathiadhas
CENTRES	Cochin, Veraval, Mumbai, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam

Plywood boats with gillnets

- Data collection on operational costs and earnings was continued in major mechanized fishery centres of the country. The economic performance of the fishing units was worked out using the cost-return and ratio analysis.
- In the mechanized sector, the average annual gross income per trip of a single day trawler in Karnataka is Rs 1,550 /- as against the gross earnings of Rs 5,295 /-. In the case of a purse-seiner, the operating cost for a single day trip is Rs 8,785 /- with net operating income of Rs 12,580 /- .
- In Kerala, the average net operating income for multi-day gillnet units (2-5 days) works out to Rs 2,700 /- with the operating cost of Rs 16,740 /-.
- In motorised sector, ring seines of Kerala fetch the maximum net operating income of Rs 5, 524 /- per trip. A motorized catamaran unit with hook and line unit in Andhra Pradesh receives a net operating income of Rs 266 /- as against the gross earnings of Rs 1,150 /- per trip.
- Resource use efficiency of different marine fishing operations has been estimated through production function & economic efficiency analysis of trawlers at all India level.
- The functional analysis was worked out using frontier production function approach adopting Data Envelopment Analysis (DEA) method. The key economic indicators of single and multi-day trawlers were worked out which indicates the probability of increasing phase of multi-day trawlers in the coming years.

PROJECT CODE	**SEETTD/ IM / 01**
PROJECT TITLE	**Impact of management and technological interventions on marine fisheries and coastal livelihood**
SCIENTISTS	**R.Sathiadhas,** E. Vivekanandan, M.Srinath, R.Narayanakumar, Sheela Immanuel, C.Ramachandran, Vipinkumar.V.P and P.S. Swathilakshmi
CENTRES	Cochin, Veraval, Mumbai, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam

- Identified location-specific management, technological and market interventions practiced in various study locations through a preliminary survey using inventorisation schedule.
- Some of the management, technological and trade regulations identified for detailed study in various locations as per the order of importance through relevancy rating are :
- (1) Ban period (annual and night fishing); (2) Modification of trawlers for tuna long lining; (3) Usage of mobile phones; (4) Usage of electronic equipments for fish locations; (5) Co-operative

marketing; (6) Regulation of minimum legal size for marketing; (7) Authorized and unauthorized entry; (8) Registration and licensing of fishing boats; (9) Regulation of fishing zones; (10) Mesh size regulations; (11) Reporting of catches and other particulars of fishing; (12) Usage of Turtle Excluder Device (TED); (13) Various processing and preservation techniques in the distribution system.

PROJECT CODE	**SEE / PMS/ 01**
PROJECT TITLE	**Price behaviour and marketing system of marine fisheries in India**
SCIENTISTS	**R.Sathiadhas** and R.Narayanakumar
CENTRES	Cochin, Veraval, Mumbai, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam

- State wise (maritime) price spread analysis for commercially important varieties of fish for 2005 was undertaken. At macro level, the percentage share of fishermen in consumer's rupee ranged from 38 % for oil sardine to 80 % for seer fish. The varieties like shark, rock cods, seer fish, pomfrets and peneaid prawns maintained a stable price between regions and seasons at primary, wholesale and retail markets.
- Completed the target of price-spread analysis for different varieties of fish. The average landing centre price at national level, ranges from Rs 14/- for silver bellies to Rs 160 /- for seer fishes in the domestic marketing system and upto Rs 600 /- for lobsters in the export marketing system. The retail price ranges from Rs 30 /- for silver bellies to Rs 230 /- for pomfrets in the domestic marketing system and upto Rs 700 /- for lobsters in export marketing system.
- Marketing margins of quality fishes and exportable varieties are comparatively less and stable in the internal marketing system.
- As a whole, there is an increase in the average price of fish of all varieties except during the post – tsunami period of Jan- March 2005.

Agricultural Technology Information Centre (ATIC)

- The Single Window Delivery System under ATIC became more effective with the sales of ornamental fish feed, dry fish products, processed products etc.
- Modified the ATIC with interior decoration and civil works in museum, sound proof audio visual room, auditorium, sales room, designing and depicting latest laminated flex posters of technologies and articulation works with specimens. The movie CDs' which were out of stock, namely Our Fish- Our Wealth (A movie on CMFRI), Monsoon Season Post Harvest Losses in Traditional Fish Processing in India, Mussel Farming in Open Sea and Estuaries in Karnataka Coastal Belts were duplicated and sold through ATIC.
- A total of 6237 farmers/ fishermen/ entrepreneurs / students visited ATIC during 2005-06.
- Made ready for releasing two new pamphlets as ATIC Technology Information Series 4 and 5 entitled 'Self Help Groups in Fisheries

Visit of World Bank team to ATIC

Sector', and 'Mud Crab' and their Hindi versions such as '*Matsyiki khetru ke Swayam Sahayak Sangh' 'Pank karkad '*, and Malayalam version of series 4 as '*Matsymekhalayile swasraya sanghangal.*

- Made arrangements for procuring new video movies of Fishery based technologies in ATIC. Duplicated the movie CDs' and DVDs' on IVLP entitled "Growing with Fish -Outreach of IVLP to *Elamkunnapuzha*" and duplicating the movie in DVD entitled 'Mussel Farming in Open Sea and Estuaries in Karnataka Coastal Belts' for sales in ATIC.
- Improved the sales of dry fish products and fresh shrimp supplied by IVLP women's Self Help Groups.
- Organised 48 farmer- students- scientists interactive discussions.
- Organised 169 film shows at the ATIC Audio Visual Room for visitors on Responsible Fisheries, BOBP series of Post Harvest Handling Fishes & other Fishery Based technologies.
- Prepared and presented an evaluation project on 'ATIC Impact Assessment' and got approved at the International Workshop on Evaluation of Capacity Building on Rural Resource Management (1st Phase) held in IARI, New Delhi during 5th – 10th March 2006 organized by Michigan State University, USA.
- Revenue generated during this financial year through sale of technological products is Rs 1,07,321 /- and that through diagnostic services is Rs 19,716 /-. Total revenue generated was 1,27, 037 /-

Sponsored Projects

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Institution-Village-Linkage-Programme (IVLP) for technology Assessment and refinement (TAR) in the coastal agro ecosystem of Ernakulam in Kerala**
SCIENTISTS	**R. Sathiadhas,** L. Krishnan, C. Ramachandran, Vipinkumar.V.P and P.K.Martin Thompson
CENTRE	Cochin

- The project was extended up to May 2005 and in the last phase, (January to May 2005), emphasis was given for the horizontal expansion of three fisheries based programmes such as monoculture of grey mullet, monoculture of milkfish and polyculture of finfish. Two animal husbandry based programmes such as Dairy farming with *paragrass and* Poultry farming with the "*Gramalakshmi"* breed and one agricultural based programme such as INM in coconut plantations also were ventured.
- A pamphlet entitled 'IVLP Experiments of CMFRI : Prioritised Techno-Interventions for Horizontal Expansion' (English version) was published by the project team.

FUNDING AGENCY	**ICAR-AP Cess Fund**
PROJECT TITLE	**Economic evaluation of trawl fishing in Andhra Pradesh and Kerala**
SCIENTISTS	**R.Narayanakumar** and R.Sathiadhas
CENTRE	Visakhapatanam and Cochin

- The preliminary economic analysis for single and multi day trawlers of Andhra Pradesh and Kerala for 2005 was completed. The economic parameters of single day trawling revealed that the average gross revenue across the landing centres in Andhra Pradesh was Rs 8948 per trip, as against Rs. 9260 per trip in Kerala. The average operating cost per trip worked out to Rs 4547 per trip in Andhra Pradesh and Rs. 6920 in Kerala. The operating ratio in Andhra Pradesh was 0.51 and the labour productivity was estimated at 34 kg/labour/trip. In Kerala, the operating ratio was as high as 0.75 and the labour productivity worked out to 26 kg/labour/trip. In single day trawlers shrimps accounted for 27 per cent of the catch contributing 36 per cent of the gross value in Andhra Pradesh as against 41.4 % of the catch with 85 % of the revenue in Kerala.
- Multi-day trawlers of 2-5 days duration in Andhra Pradesh earned a net income of Rs. 18,504 per trip as against Rs 30,569 per trip in Kerala. Operating ratio of 0.45 was observed in Andhra Pradesh with a labour productivity of 103kg/crew/trip and the same being 0.41 and 168kg/crew/trip respectively for Kerala.
- For multi-day trawlers of 5-10 days duration, the average operating costs was Rs 27,377 per trip in Andhra Pradesh as against Rs 54,387 per trip in Kerala due to higher fuel expenses and crew wages. The average gross revenue was Rs 68,182 in Andhra Pradesh while it was Rs 93,085 in Kerala. The operating ratio was estimated at 0.41 with the labour productivity of 237kg/crew/trip in Andhra Pradesh while the same being 0.58 and 173kg/crew/trip in Kerala.

FUNDING AGENCY	**Marine Products Export Development Authority**
PROJECT TITLE	**Participatory management and conservation of lobster resources along the Indian coast**
SCIENTISTS	**E.V. Radhakrishnan,** Joe K. Kizhakudan, B. Meenakumari and Pravin Puthran
CENTRE	Cochin

- During this year, two workshops were organized, one on 22 November 2005 at Veraval and another at Mumbai on 28.11.2005. The stakeholders involved in fishing, trading, exporting and various government and non-government agencies were brought on a common platform to discuss and formulate management plans for sustainable lobster fishing and conservation.
- A rally to disseminate the message of lobster conservation among fishermen, traders and exporters was held on 21 November 2005.
- The Workshop at Veraval was attended by Presidents of various Fishermen Associations, traders , seafood exporters, scientists from CMFRI, CIFT and Fisheries College and officials of Gujarat Fisheries Department, MPEDA, EIA and NGOs. The co-management approach to lobster fisheries management was discussed.
- Posters, handouts and stickers in Gujarati language were released

A lobster conservation rally passing through a Veraval fishermen colony

The President of Veraval Industries Association and the Presidents of Fishermen Organisations at Veraval jointly releasing a conservation poster

The President, Maharashtra Maachhimar Kruti Samiti releasing a lobster conservation poster at Mumbai workshop

and distributed among the stakeholders. The Presidents of various fishermen association took a pledge to release back egg bearing lobsters. The Chairman of Veraval Fishing Industries Forum pointed out pollution by industries responsible for declining lobster fishery along the Saurashtra coast.

- Representatives of fishing community, scientists, officials of MPEDA, EIA and Maharashtra State Fisheries Officials and NGOs and women selfhelp groups also attended the Mumbai workshop held on 28.11.2005 at CIFE premises.
- The President, Maharashtra Maachimar Kruti Samiti released the lobster conservation posters in Marathi and appealed to the fishing community and traders to restrict fishing and marketing of egg bearing lobsters.
- During the Workshop, the modalities of implementing fishing regulations, so as to inculcate the spirit of responsible fishing among the fishermen, were discussed.
- Regional Fishery Management Councils (RFMC) were proposed for Veraval, Mumbai and Kanyakumari districts, which will be co-ordinated by respective State Fisheries Departments.
- The videofilming of lobster fishing, trade and processing was completed at Veraval, Versova, New Ferry Wharf, Kovalam, Khadiyapatnam and Enayam fishing villages of Kanyakumari district. The final editing of the film is in progress.
- Held discussion with Director, Tamilnadu State Fisheries Department regarding formulation of RFMC for lobster fishery management in Kanyakumari district.

Lobster conservation workshop makes impact among Gujarat fishermen

The Mangrol Bandar Samaj, Gujarat in a Notification dated 27 January 2006 enforced ban on catching undersized lobsters by fishermen along the Saurashtra coast. Workshops on Sustainable exploitation and conservation of lobsters were held at Veraval, Mangrol and Porbander on 1-2 May, 2003 and on 22 November 2005 at Veraval, which were organized under the MPEDA funded project 'Participatory management and conservation of lobster resources along the Indian coast'. CMFRI has appealed to the various fishermen organizations in Gujarat to desist from capturing undersized and egg bearing lobsters in order to conserve the valuable resource. The co-management approach in lobster fisheries management has made a positive impact on fishermen and this gesture is encouraging as CMFRI has been engaged in creating awareness among lobster fishermen of the country the need for good fishing practices in lobster fishing.

Marine Biodiversity

PROJECT CODE	**MBD/01**
PROJECT TITLE	**Studies on the coral biodiversity of Gulf of Mannar Biosphere Reserve**
SCIENTISTS	**Rani Mary George,** T.S. Naomi, N.K. Sanil, Sandhya Sukumaran, K.K.Joshi and Molly Varghese
CENTRES	Mandapam, Tuticorin and Cochin

- Seventy five species of hard corals were collected from reefs around 12 islands of Gulf of Mannar and 2 reefs of Palk Bay during study period. The reefs around the islands such as Shingle, Krusadai, Pullivasal, Poomarichan, Manauli, Hare, Valai, Talayari, Mulli, Appa, Anaipar and Valimunai were surveyed and studied inorder to assess the present status of coral cover and biodiversity.
- Shingle island reefs recorded maximum average percentage live coral cover of 60.8% and reefs around Pullivasal island showed the lowest live coral coverage of 13.9%. Shannon index of diversity recorded highest value in Manauli island reefs (2.97) and lowest value in Pullivasal island reefs (1.8).
- As reef classification by coral reef morphology predicts coral reef conservation value, reefs around different islands were classified into different conservation classes based on coral morphology. Conservation classes (CC's) of 1,2,3, or 4 were assigned to reef sites dominated by massive and submassive corals (CC1), foliose or branching non – *Acropora* corals (CC2), *Acropora* corals (CC3), or with mixed coral morphologies (CC4) respectively. According to this classification reefs around different islands belonged to the various categories are given below.

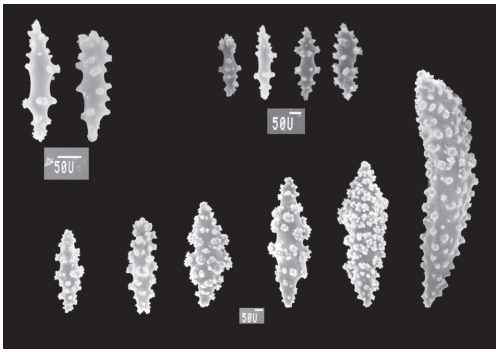
  CC1 – Pullivasal island

  CC2 – Shingle, Hare, Appa, Valai and Talayari, Mulli, Anaipar and Valimunai

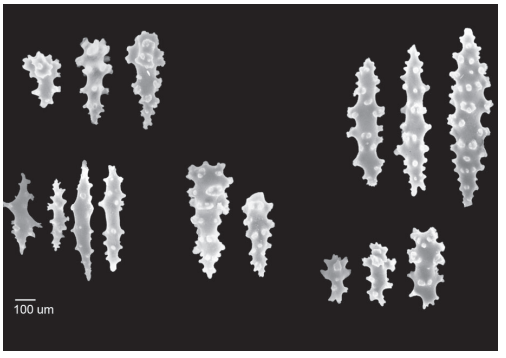
  CC3 - Krusadai

  CC4 – Manauli
- This study revealed that CC1 reefs were severely degraded. However, CC2, CC3 and CC4 were found in better health where remediation and protection efforts should be focused. As CC4 reefs had the highest coral species diversity, habitat complexity, and rare species occurrence, it is suggested that they have the highest conservation value and deserve the highest degree of protection.
- Five species of octocorals collected from GOMBR (i.e., Mandapam group of Islands) were analysed and identified as *Sarcophyton* sp. *Sinularia* spp., *Cladiella* sp. and *Suberogorgia suberosa.*
- As sclerites are the most important features used in the identification of octocorals, they were photomicrographed using scanning electron microscope and measured; their external morphology and structural characteristics were also studied and photographed for the creation of a systematic database.

Sarcophyton elegans

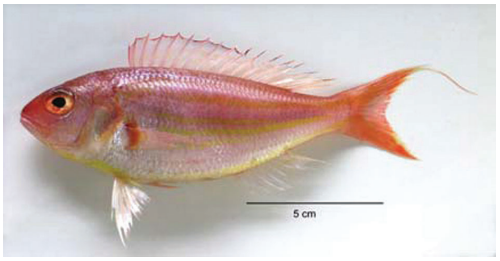


Sclerites from the lobe of *Sinularia manaarensis*

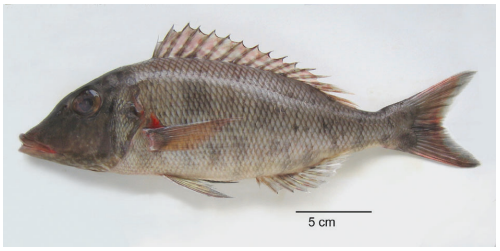


Sclerites from the stalk of *Sarcophyton elegans*

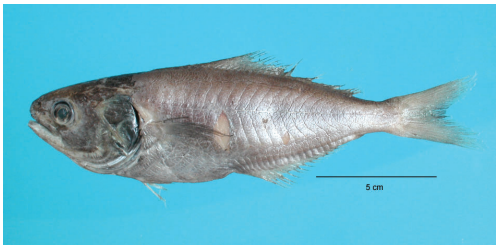
PROJECT CODE	**MBD/ 02**
PROJECT TITLE	**Species diversity of exploited marine finfish resources along the Indian coasts**
SCIENTISTS	**Miriam Paul Sreeram,** V.S.Kakati, Rani Mary George, T.S. Naomi, N.K.Sanil, S. Jasmine, Molly Varghese, K.K.Joshi, Sandhya Sukumaran, Rekha J. Nair and Sujitha Thomas
CENTRES	Mumbai, Mangalore, Karwar, Kochi, Tuticorin and Mandapam



Nemipterus randalli



Lethrinus conchyliatus



Psenopsis intermedia

- Over 390 species of finfishes under 102 families were collected from selected landing centers along the east and west coasts of India. These were identified, photographed, quantified and documented; the meristic and morphometric characters of each species estimated and a systematic database of the species developed.
- 57 species belonging to 27 families from Tuticorin, 50 species from Mandapam, 177 species of 75 families from Cochin, 187 species of 72 families from Mangalore and 130 species of 41 families from Mumbai were recorded during the period under report.
- Maximum diversity was seen within the families of Carangidae (34 species) and Serranidae (27 species), followed by Lutjanidae (17 species), Sciaenidae (16 species) and Engraulidae (15 species).
- Diversity of fishes was maximum in trawl catches followed by gill net catches. The largeheaded hairtail, *Trichiurus lepturus*, Linnaeus 1758 was the single most dominant species landed and maximum catches of the same were made by trawlers from Mumbai and Mangalore. However, the trawl fishery around Cochin and Neendakara areas showed a succession of Nemipterids followed by Trichiurids and Oil Sardine.
- A Medusafish, *Psenopsis intermedia* Piotrovsky, 1987 (Family: Centrolophidae) has been recorded from the Mangalore coast for the first time in India.
- From Cochin area and Neendakara, 15 species of finfishes as new records to the Indian seas were reported.

PROJECT CODE	**MBD/ 03**
PROJECT TITLE	**Studies on the specific and intraspecific diversity of carangids of the Indian seas**
SCIENTISTS	**K.K. Joshi,** Rekha J. Nair, Miriam Paul Sreeram, Sujitha Thomas, V.S. Kakati, S. Jasmine and Sandhya Sukumaran
CENTRES	Tuticorin, Kochi, Mangalore, Karwar, Mumbai and Mandapam

Uraspis uraspis

- At Tuticorin, 25 species of carangids were collected, identified and morphometeric and meristic measurements taken. Juveniles and adult fishes of *Carangoides armatus*, *Carangoides ferdau*, *Caranx sexfasciatus*, *Gnathanodon speciosus* and *Trachinotus blochii* showed wide variation incolour, body shape and fin structure.
- At Kochi, 27 species of carangids were collected, identified and morphometric and meristic measurements taken, data analysed and descriptions prepared.
- 9, 16 and 12 species each were collected and studied in detail at Mumbai, Mangalore, and Mandapam, respectively.
- Species collected and studied as part of this project are *Alectis ciliaris*, *Alectis indicus*, *Alepes djedaba*, *Alepes kleinii*, *Atropus atropos*, *Atule*

mate, Carangoides armatus, Carangoides malabaricus, Carangoides coeruleopinnatus, Carangoides ferdau, Carangoides gymnostethus, Caranx heberi, Caranx ignobilis, Caranx lugubris, Caranx papuensis, Caranx sexfasciatus, Decapterus macrosoma, Decapterus russelli, Elagatis bipinnulata, Gnathanodon speciosus, Megalapsis cordyla, Naucrates ductor, Parastromateus niger, Scomberoides commersonnianus, Scomberoides lysan, Scomberoides tala, Scomberoides tol, Selar crumenopthalmus, Selaroides leptolepis, Seriola rivoliana, Seriolina nigrofasciata, Trachinotus blochii, Trachinotus mookalee, Trachinotus botla, Trachinotus baillonii, Uraspis helvola and *Uraspis uraspis*

Trachinotus blochii

Sponsored Projects

PROJECT CODE	**ICAR-AP Cess Fund**
PROJECT TITLE	**Assessing the impact of fisheries on the biodiversity of marine fish resources of south-west coast of India**
SCIENTISTS	**K. S. Mohamed,** P.U. Zacharia, P.K. Krishnakumar, T.V. Sathianandan and P.K. Asokan
CENTRES	Mangalore, Kochi and Chennai

A project associate meeting conducted in April 2005 decided on the methodological approach and data analysis as shown below:

Species composition

- Different gears
- Over different fishery development phases
- Classification based on ecological niches
- Markov chain analysis

Catch variability

- Time Series
- Phase comparisons and anomalies
- Residual analysis after separating trend

Biodiversity Studies

- Phylogenetic studies using average taxonomic distinctness (AvTD) and variation taxonomic distinctness (VarTD)

Surrogate Biodiversity

- Shrimps and clupeids
- Univariate diversity indices

To start the analysis the following data mining is being carried out.

- Re-estimation of catch of KER, KAR and GOA from 1960 to 1989 from FRAD records for catch variability and species composition analysis

- Collection and estimation of trophic levels of commercial species
- Collation of life history traits of oil sardine, mackerel, shrimps and Malabar sole from **BioBase** for surrogate biodiversity

Biological reference points for selected species of shrimps

Parameters/ Species	***Acetes* sp.**	***Parapenaeopsis stylifera***	***Heterocarpus woodmasoni***	***Heterocarpus gibbosus***
Year	1971-1976	1960-1988	1967-2000	1967-2000
Length Range (B&&@&)		46-135mm	51-130 mm	51-150 mm
Length Range (B&)		31-115mm	71-130mm	76-140mm
Length Range (@&)		31-130mm	75-135mm	67-140mm
LFM		@&: 63.2mm but most 75mm; B&: 65mm	93mm	88mm
Fecundity		39500 at 70mm & 236000 at 120mm		
Spawning season	Continuous	Through-out year, Mar-May, Oct-Dec	Through out year	Jan-Mar
Peak Spawning	Nov-Dec & Mar-Apr			Feb-Mar
Recruitment	Continuous	2: After Feb & after Aug		
Peak Recruit		Nov-Jan, Mar-Jun		
Lr		10-145mm, <65mm		

Mariculture

PROJECT CODE	**MD/CUL/01**
PROJECT TITLE	**Seed production for shell fish mariculture**
SCIENTISTS	**K.R. Manmadhan Nair (PI),** E.V. Radhakrishnan (Co-PI), P. Muthiah, S. Dharmaraj, V. Kripa, G. Maheswarudu, K.K. Philippose, Josileen Jose, I. Jagadis, M.K. Anil, Shoji Joseph, and Joe. K. Kizhakudan
CENTRES	Mandapam, Calicut, Cochin, Tuticorin, Visakhapatnam, Vizhinjam and Chennai

Shrimp

- 4.3 million postlarvae of *Penaeus semisulcatus* were produced and searanched.

Marine crab

- 53 million zoeae of *Portunus pelagicus* were obtained from breeders and 13449 hatchery produced baby crabs were sea ranched.

Larval transportation

- Zoeae and baby crabs of *Portunus pelagicus* were transported from Mandapam to Calicut in oxygen packing and water cooled to 24^0 C. 50% survival obtained after 20 hrs. of transport.

Lobster

- The phyllosoma larvae of *Panulirus homarus* reared at Cochin attained stage VIII in 42 days for the first time. Larvae were fed with *Artemia* nauplii, enriched sub-adult *Artemia* and the arrow worm *Sagitta* sp. during different stages of development. In another experiment, larvae attained stage VIII in 47 days on an exclusive diet of *Artemia*. Sizes of *Artemia* for different larval stages were determined.

Pearl oyster

- From 10 lakhs 'D' larvae of *Pinctada fucata*,1500 spat were produced at Tuticorin Research Centre. The spat were transported to Vizhinjam for further experiments.

Cuttle fish

- *Sepia pharaonis* egg capsules collected from FADs (Coconut spadix) were incubated and hatched in the laboratory. Larvae after 3 months attained 31-41 mantle length at a survival rate of 89%.

Remote setting

Remote setting of the clam *Paphia malabarica* and pearl oyster *P. fucata* was achieved for the first time in India. 10.8 times increase in growth observed in pearl oyster larvae shifted to marine farm after 45 days of rearing in hatchery.

FAD unit for egg capsule collection of *Sepia pharaonis*

Hatchery produced *Sepia pharaonis*

PROJECT CODE	**MD/CUL/02**
PROJECT TITLE	**Development of diversified and sustainable mariculture grow-out systems**
SCIENTISTS	**V.Kripa (PI),** P.Muthiah (Co-PI), K.K.Appukuttan, T.S.Velayudhan, K.S.Mohamed, Reeta Jayasankar, L.Krishnan, Josilin Jose, Boby Ignatious, K.P.Said Koya, P.Laxmilatha, Gulshad Mohamed, Geetha Sashikumar, P.K.Asokan, G.Gopakumar, Kaliaperumal, Manmadhan Nair, P.Vijayagopal, A.C.C. Victor, S.Dharmaraj, I.Jagadis, P.V.Sreenivasan, G.Syda Rao, Joe Kizhakudan and A.K. Unnithan
CENTRES	Cochin, Minicoy, Calicut, Mangalore, Veraval, Mandapam, Tuticorin, Chennai, Vishakapatnam and Kakinada

PEARL CULTURE

Remote set seed of *Paphia malabarica*

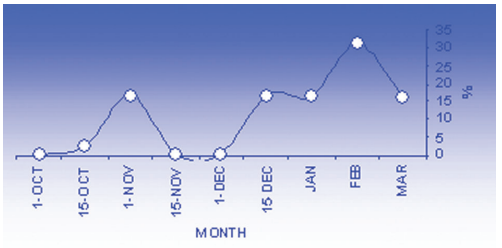
- Multiple mabe pearls produced from individual pearl oysters, *Pinctada fucata* at Lakshadweep. In the raft farm, 3 to 4 images were placed in individual oysters which were coated with good quality nacre producing mabe pearls in 90 days during September to December. The grading of quality of the mabe pearls harvested (in percentages) were – 23. 5 'A 'grade, 30.8% 'B' grade, 30.8% 'C' grade. Mortality and rejects amounted to 15.3%.
- Mabe pearls were produced in land –based cement tanks by rearing *P.fucata* under controlled conditions for a period of 75 to 90 days. Rearing protocol for on shore mabe pearl production : stocking density -one implanted oyster L^{-1}; rearing container – netlon pouches 10 x 10 cm - one oyster per pouch ; water quality – salinity 32 ± 2 ppt, good aeration; water exchange- 50% in three days and feed - mixed algal diet in a continuous drip feeding system with a flow rate of 50 L hr^{-1}.
- Two high priced pearl oyster species viz. the silver lipped *Pinctada maxima* and the black lipped *Pinctada margaritifera* reared in land based / on-shore pearl culture system.
- The **first in-vitro pearl with the visible nacre coating** produced from the mantle tissue of abalone. Further research program related to organ transplants of window pane oyster mantle tissue and effect of intermediate feeding gave good results. Good proliferation of cells and pearl sac formation was obtained in pearl oyster mantle tissue culture. In darkness pseudopodial formation and development of granules was observed. The protein alanine tested in pearl oyster gave adverse effect such as low cell proliferation while five proteins tested in abalone gave good proliferation.

A mussel farmer using the mussel de-clumper

MUSSEL FARMING

- An efficient and easy to handle semi-automated de-clumping machine (Prototype II) was designed, fabricated, field-tested and launched among the mussel farmers marking mechanization in harvesting in mussel farming in India. Relief from physical exertion during harvesting especially for women and improvement in hygiene in the harvesting process are the main advantages. Prototype II is detachable, light weight and can be easily transported.
- Mussel declumper (Prototype II) : Estimated production cost : Rs 4500 per unit. Efficiency : complete detachment (declumping) of 7 to 10 kg mussels from one meter mussel rope in two minutes. Field tested in the mussel farms of Korapuzha and Padanna in North Kerala.

- Experiments conducted at Chaliyar, Kerala to compare the variation in growth and production of the green mussel *Perna viridis* when stocked vertically and horizontally in the rackfarm indicated that the production was 18.4 kg m^{-1} in vertically suspended rope while it was slightly lower, 14.2 kg m^{-1} when the ropes are tied horizontally. However, the variation in production rates were not statistically significant. These two methods of stocking are common in commercial mussel farms of Kerala.
- In the demonstration cum experimental farm at Vellar estuary, green mussel seed of average length 22.0 mm and weight 1.1 gm grew to 75.8 mm with an average shell-on weight of 24 g.



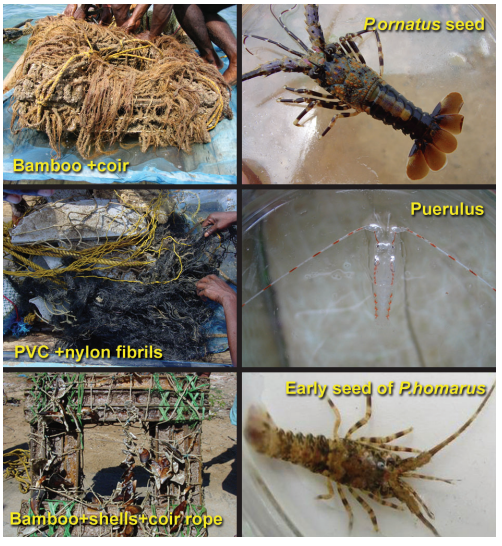
Percentage of total spat settled during October-March at Bappanadu, Mulki

OYSTER FARMING

- The settling density of *Crassostrea madrasensis* spat on cultchs placed perpendicular to the flow in Bappanadu area of Mulki were significantly (P>0.05) lower when compared to those kept parallel to the river bank indicating that strong current interfered with larval settlement. For single spat collection, oyster shell grits gave better results when compared to clam shell grits as mini cultch.
- At Navibunder the spat of *Crassosttrea gryphoides* was found to settle and the density was 4 to 8 nos per shell during Feb -March.
- Variation in growth of the yellow clam *Paphia malabarica* by on –bottom and off –bottom method was studied. In the off-bottom method, seed clams of 9.3 mm had a growth rate of 3.4 mm $month^{-1}$ while in on-bottom system, the corresponding growth rate was 0.2 mm $month^{-1}$. The seed clams grew to 33.2 mm and 11.02 mm in the off-bottom and on-bottom culture systems with a corresponding survival rate of 65 and 95 % respectively.
- Remote-set seed of *Paphia malabarica* (larvae produced at Tuticorin and set at Calicut) when transplanted from lab to farm in the Moorad estuary, Kerala showed a survival of 70% with an length increment of 4.35 mm in 15 days. This result implies the scope for stock enhancement and farming of the yellow clam using larvae produced in distant hatcheries.

LOBSTER FARMING

- **Sand lobster fattening** : Experiments on fattening of the sand lobster *T. orientalis* of carapace length (CL) ranging from 30 – 35 mm (18 – 25g weight) was carried out at Chennai. The young ones stocked at a density of 9.2 $sq.m^{-1}$ in rectangular cement tanks with floor covered partially with river sand substrate grew to 40 – 64 mm CL with increments of >60g in weight in 80 days (partial culling was done). The average meat yield was 35.53% of total weight.
- **Lobster seed (puerulus) collection techniques :** Three different models of puerulus collectors viz (1) bamboo frame and coir rope (2) PVC sheet and polypropylene thread tuft and (3) bamboo splits with mussel shells and coir ropes with ample protective and hiding niches to suite the behaviour of the lobster larvae were designed and fabricated. These were kept drifting at a height of 1 m above the sea bottom at 6-8m depth. Puerulus of *P.homarus* (1 to 2 nos) were obtained during February-March.



Different types of lobster seed collectors and the seed of lobsters obtained in these collectors from coastal waters of Chennai.

Farmers drying the harvested seaweed from the raft farm at Njarakkal

Harvested *Kappaphycus alverezii* at Thikkodi, which was cultured on nylon rope and placed at the bottom

SEAWEED FARMING

- Pilot scale culture of *Kappaphycus alvarezii* was carried out by the vegetative propagation method on bamboo rafts at a depth of 1.5m at Palk Bay and Gulf of Mannar. From 93 rafts with seed of *K. alvarezii* in Palk Bay and 4 rafts in Gulf of Mannar and one raft with *Gracilaria salicornea* 8.74 tonnes of seaweed was harvested from a seed quantity of 2.325 tonnes.
- Experimental onshore culture of *K. alvarezii* in one tonne fiberglass tanks with running seawater and aeration gave maximum increase in biomass of 185% after 56 days of culture in the seed material which was pre treated with superphosphate at a concentration of 10 mg L^{-1}.
- Along Gujarat coast the weight of *K. alvarezii* was found to increase by 5 times in 60 days.However, in certain areas of Navibunder, siltation was a problem and growth was poor.
- Integrated farming of the red seaweed *Gracilaria verrucosa* and the tiger shrimp *Penaeus monodon* initiated at Njarakkal near Kochi during June 2005 was continued for 120 days. One of the salient observation was that the stocked shrimp were not affected by virus while in the adjacent control pond mortality due to virus attack was observed. In the treatment pond, the weight of the shrimp ranged from 13 to 20 g whereas it was 10-15 g in control pond. The production of seaweed was more than 1 tonne yielding 8-17.6% of agar.
- A standard method was developed for the extraction of carrageenan for optimum yield and quality. Carrageenan was extracted from the seaweed *Kappaphycus* cultivated at Mandapam from 10-90 days at an interval of 10 days. Maximum yield was 53.54%.
- Pilot farming of K. *alvarezii* was carried out in the open sea off Narakkal from December 2005 to March 2006 in an area of 1000 m^2. Fragments of seed in 1500 nylon net bags were stocked in the raft. Partial harvest of 176 kg was done after 45 days.
- Feasibility of monoculture of *Kappaphycus alvarezii* in the intertidal rocky areas along west coast in different grow – out structures was tested by conducting trials at Thikkodi, Kozhikode district. The growth and yield of seaweed farmed by different grow –out structures viz, floating raft, fixed bottom nylon rope method and nylon net method showed variation. Nylon net culture method was not successful due to heavy accumulation of sediments during monsoon.
- Integrated farming of seaweed with green mussel during December 2005 to February 2006 indicated 18 to 23 fold increase in yield in 46 days with an IGR of 0.06 ± .01 kg per day. Large scale field testing cum integrated farming were initiated in the mussel farms by 100 farmers of Kasargode district, Kerala.

FINFISH FARMING

- Finfish seed availability was studied at Hare Island, Mandapam. In January, from a five minute haul using a drag net (10m x 5m) 150 juveniles of *Siganus canaliculatus* of length ranging from 20 to 40 mm and 100 nos of seed of catfish *Plotosus lineatus* with length 15 to 17 mm were obtained.

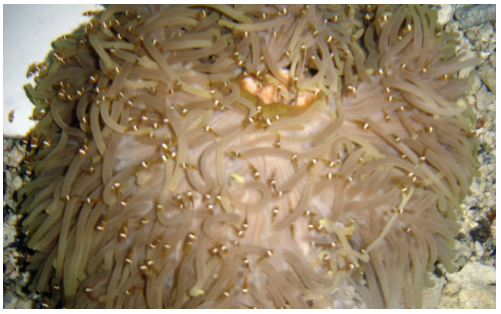
PROJECT CODE	**MD/CUL/03**
PROJECT TITLE	**Broodstock development and seed production of finfish**
SCIENTISTS	**G. Gopakumar,** Grace Mathew, L. Krishnan, D. Noble, K. Madhu, Rema Madhu and Boby Ignatius
CENTRES	Mandapam, Vizhinjam and Cochin

- Broodstock development, breeding and one successful experiment on seed production of *Epinephelus merra* was conducted. The fishes above 30 cm formed pair and natural spawning was obtained. During August-September 2005, seven spawnings were noted. The periodicity of spawning ranged from 3 to 12 days. The approximate number of eggs in the different spawnings ranged from 11,220 to 63,020. The average length of the newly hatched larva was 1.5mm.
- One batch of *E.merra* was successfully in the produced hatchery by applying greenwater technique and employing the nauplii of copepods as the starter feed.
- The larvae started metamorphosing from 40th day onwards and all the larvae metamorphosed by the 60th day.The young ones ranged from 20-64mm in total length.
- Six broodstock tanks each containing two pre-adult fishes of E. *malabaricus* were set up. The two fishes in each tank were separated by a net partition and the larger fish is being administered with 17" methyl testosterone along with feed for sex reversal.
- One broodstock tank of *Siganus canaliculatus* was set up and the fishes were fed with trash fish, squid meat and filamentous algae.The length of fishes ranged from 21-30cm.
- One broodstock tank was set up for *S. javus* with six numbers of pre-adults and are being fed with trash fish, squid meat and filamentous algae.
- One broodstock tank was set up for the pompano *Trachinotus blochi* with eight numbers of pre-adult fish. The broodstock fishes are being fed *ad libitum* with trash fish and squid meat.
- Broodstock development and larval rearing were achieved for three species of ornamental fish *viz.* the three spot damsel (*Dascyllus trimaculatus*), striped damsel (*Dascyllus aruanus*) and the blue damsel (*Pomacentrus caeruleus*).
- The green water technique with sufficient nauplii of copepods was the key factor for the success of early larval rearing. The second generation matured and spawned in the hatchery at eleven months of age.
- The methodology for hatchery production of blue damsel was standardised and a total of five batches of about 100 numbers each were hatchery produced.
- Broodstock development and breeding of *Dascyllus carneus* was achieved. The newly hatched larvae measured 1.72 -1.82mm in length.
- Spawning of *A.ocellaris* was obtained and methods of hatchery production of juveniles were standardised for the first time in India.

Hatchery produced juveniles of *Epinephelus merra*

Hatchery produced young ones of striped damsel

Hatchery produced young ones of the blue damsel *Pomacentrus caeruleus*



15 day old juveniles of *Amphiprion ocellaris* settling in sea anemone *Heteractis magnifica*

- The larviculture protocols were developed and during the 15th to 17th day of hatching the larvae metamorphosed into juveniles. A total of 6000 seeds were produced.
- Spawning of *A.percula* was obtained and methods of hatchery production were standardised.

PROJECT CODE	**MD/CUL/04**
PROJECT TITLE	**Mass culture of live feeds and nutritional enrichment for larviculture**
SCIENTISTS	**G. Gopakumar,** Reeta Jayasankar, Josileen Jose, Gulshad Mohamed, Boby Ignatius, Shoji Joseph, Joe K. Kizhakudan, P. Vijajayagopal and Molly Varghese
CENTRES	Mandapam, Calicut, Cochin and Chennai

The calanoid copepod *Pseudodiaptomus serricaudatus*

Nauplius of *Pseudodiaptomus serricaudatus*

- Trials were made for studying the utility of different species of copepods as first feed for fish larvae with very small mouth gape.
- It was found that copepods which produce NI of size 50-60µ are suited for the rearing of these larvae. Based on the same two species one calanoid *Pseudodiaptomus serricaudatus* and one harpacticoid *Euterpina acutifrons* were selected.
- The adults of *Pseudodiaptomus serricaudatus* ranged from 643-728µ, the NI ranged from 51-64µ, the last stage nauplii measured 185-190µ, the copepodite stages measured 200 - 514µ.
- One experiment each on the semicontinuous culture of *P.serricaudatus* and *E.acutifrons* was conducted. In both the cases cultures could be maintained in healthy condition for about a month. Multiplication of *E.acutifrons* was faster when compared to *P.serricaudatus.*
- The larval survival rate of blue damsel, striped damsel, three spot damsel and honeycomb grouper was directly proportional to the density of nauplius in the rearing tank. The larval survival rate can be increased by maintaining higher density of nauplii.
- The introduction of rotifers along with copepods in the larviculture tanks during the first fifteen days resulted in the blooming of rotifers which led to the mass mortality of the larvae.
- In the larviculture of *A.ocellaris* better survival was obtained by feeding the larvae with *Artemia* nauplii enriched with mixed microalgae.
- Enrichment studies of rotifers with *Nannochloropsis* sp. showed that six hours of enrichment was sufficient for maximum enrichment.
- Rotifers fed with *Nannochloropsis* had 96.04 microgram lipid compared to 53.33 with *Tetraselmis*, 41.50 with *Isochrysis* and 33.0 with *Dunaliella* in mg of tissue.
- Four new strains of microalgae were isolated from Cochin and Andaman waters.
- The arrow worm *Sagitta enflata* was found to be a better feed for phyllosoma stages I and II of *Thenus orientalis* whereas advanced phyllosoma stages preferred the ctenophore *Pleurobrachia bachiae*.

The harpacticoid *Euterpina acutifrons*

Sponsored Projects

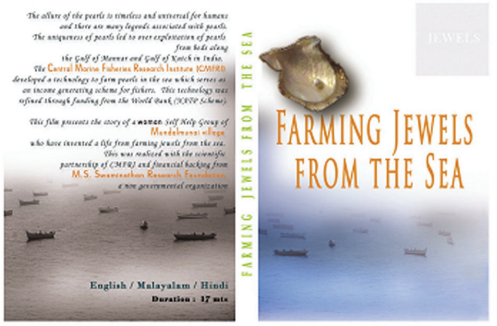
FUNDING AGENCY	**ICAR - A P Cess Fund**
PROJECT TITLE	**Brood stock development, larval rearing and seed production of marine crab *Portunus pelagicus***
SCIENTISTS	**K.R. Manmadhan Nair** and Josileen Jose
CENTRE	Mandapam

Experiments to develop broodstock of *Portunus pelagicus* in captivity have been carried out in 6.5 ton circular FRP tanks provided with in-situ biological filter and air lift water re-circulation system. A progressive reduction in re-maturation and spawning performance was noticed in the experimental animals with 72.5% spawning once, 20% spawning twice and only 7.5% spawning a third time during the course of the experiments. 51.9 million zoeae produced in these experiments were sea ranched. In larval rearing experiments a total of 11227 baby crabs were produced and sea ranched.

Crab broodstock development facility at Mandapam R. C. of CMFRI

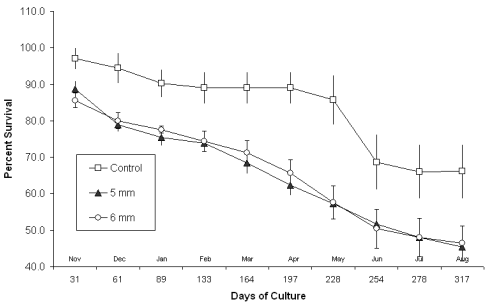
FUNDING AGENCY	**NATP/PSR**
PROJECT TITLE	**Breeding and culture of pearl oysters and production of pearls**
SCIENTISTS	**K.K. Appukuttan,** K.S. Mohamed, V. Kripa, T.S. Velayudhan, D.C.V. Easterson, A.C.C. Victor, S. Dharmaraj, N. Ramachandran and M.K. Anil
CENTRE	Cochin, Tuticorin and Vizhinjam

- The technology of marine pearl production was upgraded by developing the technique for producing *large diameter pearls similar to Japanese Akoya*; and a new technology was developed for *producing Mabe (image) pearls* with low gestation period.
- Project scientists were able to organize the *First Indian Pearl Congress and Exposition, where, more than 125 national delegates* participated and deliberated on the pearl culture scenario (both marine and freshwater) in the country. The deliberations resulted in a *major policy document on development of pearl culture in the country*. These recommendations were given to the respective Ministries and agencies.
- The project could also accomplish the making of a 15 minute video film entitled *Farming Jewels from the Sea* highlighting the activities and achievements of the project for wider dissemination.



Production of 6 to 8 mm Akoya pearls from the Southwest coast of India

- The Indian pearl oyster *Pinctada fucata* (Gould) is typically capable of producing pearls of 3-5 mm diameter. The feasibility of production of pearls similar to Akoyas of 6-8 mm diameter was studied from the southwest coast of India.
- A total of 706 oysters were implanted, 311 with 5 mm, 395 with 6 mm nuclei and stocked in 30 cages for a period of 317 days.
- The mortality rates were highest, 0.173 ± 0.22 for the 6 mm nucleus implanted oysters followed by 5 mm nucleus implanted oysters at



Percent survival in implanted oysters

0.107 ± 0.025 during the first 30 days after implantation. These rates were significantly different ($P < 0.05$) from the mortality rate of the control oysters (0.042 ± 0.04). The retention rates based on the surviving oysters, ranged from 33 to 61% (average 45.9 for 5 mm) and 31 to 60% (average 48.9% for 6 mm).

- The nacre deposition rates on the nuclei were found to be 0.004 ± 0.001 mm day -1 and 0.003 ± 0.001mm day -1 for 6 and 5 mm nuclei, respectively.
- Of the total of 131 pearls obtained, 27.6% were A-grade, 31.3% B-grade, 19.8% C-grade, 7.6% baroques and 13.7% rejects or trash.
- The total suspended solids (TSS) in the water were found to be positively correlated ($P < 0.05$) to the monthly mortality rate of the implanted oysters.
- The study showed that it was possible to obtain relatively thick nacre in a very short period (within 10 months), the deposition rate being about 9 times higher than that observed in Japanese waters and 2.2 to 2.3 times more than along the Indian southeast coast.

FUNDING AGENCY	**DOD**
PROJECT TITLE	**Farming and pearl production in the black lip pearl oyster**
SCIENTISTS	**M. J. Modayil,** K.K. Appukuttan, K.S. Mohamed, T.S. Velayudhan, V. Kripa, S. Dharmaraj and I. Jagadis
CENTRE	Port Blair

New raft deployed at Havelock Island, Andaman and Nicobar Islands

- Deployed new raft in Havelock Island for spat collection and grow-out.
- Setup hatchery facilities including cartridge filters and air lines.
- Setup algal culture facility with stock and mass cultures.
- Setup broodstock facility and conducted 4 spawning trials. Larvae reared for 12 days (D-shaped).
- Implanted nucleus and base mabe images in *P. margaritifera* and *Pteria penguin*. Mabe pearls produced in *P. margaritifera.*
- Oyster surveys were organized by both snorkeling and SCUBA and collected more than 100 adult oysters.

Efficiency of commercial adhesives in image fixation in *Pinctada margaritifera* and *Pteria penguin*

- Three different adhesives containing zinc oxide, polycarboxylate as principal component and Fevikivk™ were used for mabe implantation in the black-lip pearl oyster and the winged pearl oysters. Implantation trials were conducted on two size groups of oysters (>150 and < 150mm) and the efficiency assessed as a measure of rejection rates and survival of oysters. Immediate rejections if any were observed in the lab 6 h after implantation and the oysters which retained the images were stocked in tagged cages.
- Survival was 100% in all the trials but the gluing efficiency varied. Commercial glues with zinc as a component could not retain the image whereas glues containing Polycarboxylate (PC) and Fevikwik™ gave good results (> 80% retention).
- The setting time ranged between 45 to 50 seconds and there was no damage to the mantle and other internal organs of the implanted oysters.

Fixation was equally efficient in the all the sites on the shell namely ventral, middle anterior and posterior and the lower dorsal regions on both the oysters.

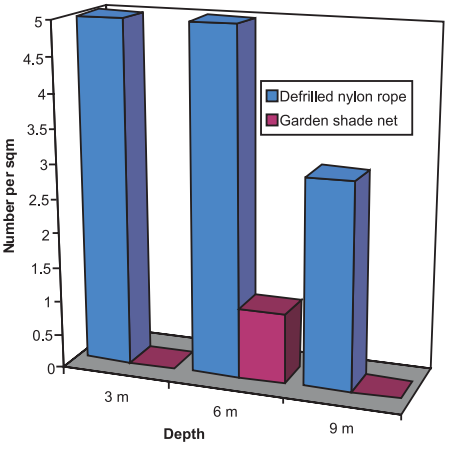
Standardization of the dosage for anaesthetizing *Pinctada margaritifera* and *Pteria penguin*

- Two anaesthetizing chemicals *viz.*, Menthol and Eugenol were used to narcotize the pearl oysters prior to mabe implantation. Three doses 0.25 ppm, 0.37 ppm and 0.75 ppm were tried on two size groups of oysters (>150 and < 150mm). The stocking density was maintained at 2 oysters L^{-1}.
- The three doses had almost the same effect but the time taken to relax the muscles and the animals to be fully narcotized was higher for oysters with DVM >150 mm than for oysters with DVM <150 mm. The smaller oyster gaped in 50 min while the larger oysters took 95 min.
- The recovery (loosing the anesthetic effect) when placed in fresh seawater after implantation was within 15 min for all the oysters. The survival during 30 days was 100% indicating that this dosage does not have any lethal effect.

Experiments on natural spat collection at Havelock Island, (effect of depth on spat settlement)

- Two different spat collectors namely defrilled nylon rope and garden shade net were suspended from the raft and the settlement of spat at 3, 6 and 9 meters was observed. Each nylon rope spat collector consisted of two, 130 cm long, 12 mm nylon ropes twisted together with the strands separated and each garden shade net was folded upon itself to form a 50 cm x 50 cm sheet with 2 inner and 2 outer surfaces.
- *P. margaritifera* spat was obtained from all the depths with a maximum from 3 and 6 m depth. Among the two collectors, nylon rope had better spat settlement than garden shade.

Triplet mabe in *P. margaritifera*



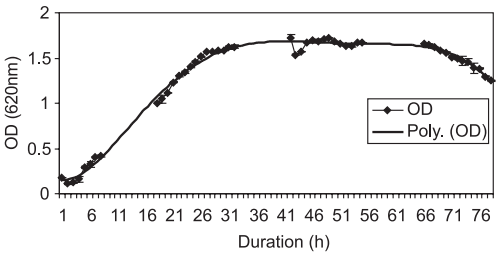
Effect of depth on *P. margaritifera* spat settlement

FUNDING AGENCY	**ICAR-AP Cess Fund**
PROJECT TITLE	**Technology upgradation in edible oyster farming through development of remote setting and floating upwellar techniques**
SCIENTISTS	**PI - V.Kripa,** Co PI - K.Sunilkumar Mohamed
CENTRE	Calicut and Cochin

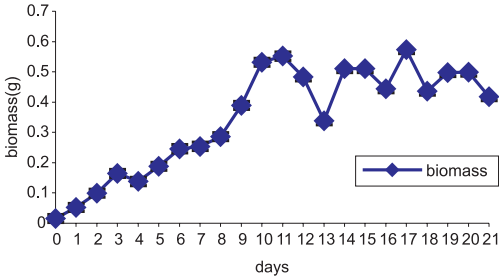
- 4.75 lakh pediveliger larvae of *Crassostrea madrasensis* produced in the Shellfish hatchery of CMFRI at Tuticorin were transported in dry moist condition under low temperature (21.5±0.5^{0}C and 28 ±0.5^{0}C) covering a transit period of 20 hrs. The percentage survival was 78.7% and settling rate was 2.3%.The settlement on different cultch material varied and was highest on oyster shell rens (60%) and low (4.5%) on clam shells.
- Two oyster farms of 5 x 5m were set up, one in North Kerala at Vallikunnu in Malapuram district and another at Sattar Island in central Kerala in Ernakulam district and these were stocked with 1000 remote set, spat on rens.
- A bivalve farmers meet was organized at Vallikunnu and an awareness program on improvement in bivalve farming through utilization of remote set spat was conducted. Nearly 9000 spat, which settled on shell, clutches were shifted to bivalve farms owned by small-scale farmers in Vallikunnu. This is the first time in the country that remote set spat are used in farming.

Physiology
Nutrition
Pathology

PROJECT CODE	**PNP/NUT/01**
PROJECT TITLE	**Development of cost effective and ecofriendly feeds for cultivable marine crustaceans and finfish by biotechnological interventions**
SCIENTISTS	**R. Paul Raj,** Imelda Joseph, Kajal Chakraborty, P. Vijayagopal, D.C.V. Easterson, D. Kandasami and Margaret Muthu Rethinam
CENTRES	Cochin, Mandapam, Chennai and Tuticorin



Growth phases of phytase producing *Bacillus licheniformis* MTCC 6824



Variation in biomass of *Aspergillus niger* S14 during 21 days of SSF

Study of growth phases of phytase producing *Bacillus licheniformis* MTCC 6824 in submerged fermentation system

- Study of growth kinetics of phytase producing *Bacillus* and *B. coagulans* in submerged fermentation system for a period of 76 h has shown that the percentage biomass was the maximum at 31 h which then remained stationary till 66h and then showed a declining trend till 76 h.

Growth kinetic profiles of *Aspergillus niger* $S_1$4, a mangrove fungus in solid-state fermentation

- A study was conducted to fit the empirical equations and growth models commonly used in elucidating the dynamic nature of growth to the data of biomass and its components, protein and glucosamine contents of a mangrove fungus, *Aspergillus niger* $S_1$4 in solid state fermentation (SSF) with wheat bran as substrate. Linear, exponential, logistic equations and two phase model were fitted to the measured growth indicators like biomass, protein and glucosamine contents. Models based on logistic equation like, Richards, Michaelis-Menten, Weibull, Modified Gompertz and Morgan-Mercer-Flodin were also fitted to the data.

Isolation and characterization of new strains of phytase producing bacteria from mangrove swamp

- Four strains of *Bacilli* capable of producing phytase were isolated from mangrove system using PS medium and its species characterization was done at IMTECH, Chandigarh. The strains were identified as *Bacillus circulans* MTCC 7635, *Bacillus circulans* MTCC 7636, *Bacillus sp.* MTCC 7637 and *Bacillus pantothenticus* MTCC 7638. The cultures were deposited to IMTECH, Chandigarh and also being maintained in the laboratory for further use in SSF.
- Evaluation of one feed prepared using *Bacillus licheniformis* MTCC for feed acceptance in *Amphiprion ocellaris* is being experimented

Nutritional enrichment of tuna waste and vegetable waste by solid state fermentation

- An experiment was conducted to study the improvement of nutritional profile of vegetable waste using *Aspergillus niger* strain $S_1$4 isolated from mangrove swamp in SSF. Improvement in crude protein, and crude fat was observed with reduction in dry matter and total carbohydrate for a period of 8 days. Another experiment was conducted to study the improvement of nutritional profile of

fermented tuna waste using *Lactobacillus plantarum* and *Bacillus licheniformis*.

Purification and characterization of acid phosphatase in fermented products

- Acid phosphatase is used as animal feed supplement to negate the anti-nutritional effects. Acid phosphatase has been purified from *Bacillus licheniformis* MTCC 6824 isolated from mangrove ecosystem and the enzyme activity of the purified fraction was found to be 24.6 X 10^6 PhU/gm at pH 5.5 and 39^0C. The crude enzyme had maximal phytase activity (3304.58 APU/mL) and specific activity (7.18 X 10^5 APU/g proteins) at pH 5.5 and 39°C.

Nutritional response to experimental diets containing graded levels of fish meal on different size groups of shrimp *Penaeus semisulcatus*

- Nutritional response to experimental diets containing graded levels of fish meal on different size groups of shrimp *Penaeus semisulcatus* (mean initial weight 0.260g) evaluated. Experimental results revealed that the growth rates were poor and after 22 days of experimental duration mortality rates were high.

Nutritional response to experimental diets containing graded levels of fishmeal by shrimp *Penaeus semisulcatus* (mean initial weight 0.260 g)

Feed Nos.	I	II	III	IV	V	VI	VII
% fish meal replacement	0	5	10	15	20	25	30
Initial biomass shrimp^{-1}g	0.261	0.238	0.272	0.253	0.261	0.241	0.293
Final biomass shrimp^{-1}g	0.698	0.762	0.792	0.823	0.811	0.832	0.845
Percent weight gain	168	221	192	226	211	245	188
Percent survival	35	38	48	52	52	58	54
Feed efficiency	22	25	26	29	29	31	33
Protein efficiency ratio	1.140	1.280	1.350	1.380	1.390	0.410	1.400

Evaluation of PUFA from different source of fishmeal and an oligochaete

- In order to identify natural marine ingredients having fatty acid profiles conducive for larval nutrition and brood stock nutrition, two samples of fish meal, shrimp and the oligochaete *Pontodrilus bermudensis* were profiled for their fatty acid content. The DHA:EPA:ARA ratios were recorded as follows. Fishmeal (Ramanathapuram) DHA 6.66; EPA 0.66; ARA 0.39; (Mandapam) 3.62: 6.42: —: , Shrimp meal(Cochin) 4.97:10.63: 0.72; *Pontodrilus bermudensis* 16.89;24.79; 0.73.

Use of feed attractants for the rearing of spiny lobster *Panulirus homarus*

- Use of chemo-attractants (Soya lecithin) used at the rate of 0 to 5% in the semi moist diet, indicated higher growth rate and FCR of 74.40% and 1.44 respectively at 3% level in the diet. Inclusion of 2.0% has shown growth of 35.35% and FCR of 3.18. The other

levels have shown lesser growth rate. The spiny lobster *Panulirus homarus* requires 2-3% soya lecithin in the formulated diet.

- Spawning of swimming crab *Portunus pelagicus* maintained on formulated feed has been achieved.

Effect of semi moist feed for the swimming crab *P. pelagicus*

- Effect of semi moist feed for the swimming crab *P. pelagicus* was evaluated. Crab fed with semi moist have showed higher growth of 47.28% and FCR of 2.91 followed by the dry pellet with growth of FCR 45.3 and 1.91, respectively. It is also noted that the growth and FCR is above the control (4.17) for the semi moist and dry pellet.

PROJECT CODE	**PNP/BIOT/01**
PROJECT TITLE	**Biotechnological interventions in disease diagnosis and management in mariculture**
SCIENTISTS	**P.C. Thomas,** K.K. Vijayan, A. P. Lipton, KC.George, K. S.Sobhana, N.KSanil and Kajal Chakraborty
CENTRES	Cochin and Vizhinjam

Disease monitoring, isolation and characterization of mariculture pathogens

- Out of 371 fishes infected with disease causing microbes in the marine aquarium (CMFRI, Vizhinjam), major diseases were tail rot, fin erosions, ulcer on the body, skin peelings, white patches and exophthalmia.
- Eight bacterial pathogens from the marine ornamental fishes and ten from pearl oyster larvae were isolated. Four of the isolates from pearl oyster larvae were identified to be of *Vibrio* species.
- Pathogenecity of 15 isolates of *Vibrio anguillarum* from diseased *Penaeus indicus* tested through injection challenge of *Fenneropeneus indicus* juveniles showed that a dose of 10^6 cells/shrimp caused 100% mortality with in one day of challenge in the case of 9 strains, whereas in 5 strains a dose of 10^7 cells/shrimp was needed for 100% mortality within a day. One strain did not cause mortality even at 10^7 cells/shrimp on the 10^{th} day post challenge.
- Out of 5 strains of *Vibrio parahaemolyticus* evaluated for pathogenecity in the grouper, *E. malabaricus* 2 strains caused mortality with in 4 days post challenge at a dose of 10^6 cells/g fish (i.p injection) whereas no mortality was recorded for the other 3 strains
- The isolate obtained from *Chaetodon* sp. caused mortality among Blue damsel fish at 10^6cells per fish. The butterfly fish, *Chaetodon* sp., recorded high mortality.

Fin erosions in Blue damselfish experimentally exposed to pathogenic *Vibrio* isolated from Butterfly fish

Molecular genetic profiling and development of molecular and immuno diagnostics and vaccines for bacterial pathogens

- DNA fingerprint pattern of bacterial pathogens isolated from mariculture systems (*Vibrio parahaemolyticus* and *Aeromonas hydrophila*) were developed.
- Molecular level identification of *V. parahaemolyticus* using species specific primers has been accomplished using custom synthesized oligonucleotide primers.

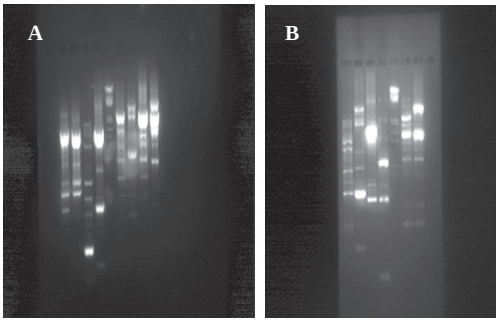
- Detection of pathogenic strains of *V. parahaemolyticus* through the PCR amplification of virulence related genes are under trial.
- Plasmid DNA fingerprinting of *Aeromonas hydrophila* isolates from mariculture systems using Plasmid DNA as templates for PCR amplification with Operon decamer random primers have been completed and the most salient findings are presented.
- Comparison of the 93 individual amplicons (0.20Kb to 4.5Kb size) revealed an overall polymorphism of 86.02% reflecting the intra-species extra chromosomal DNA heterogeneity. While 13 of the amplicons were species-specific, shared by all samples, 80 were not.
- Antisera against *V. alginolyticus* and Counter immuno electrophoretic technique for *V. anguillarum* have been developed.
- Cell surface proteins have been extracted from 10 pathogenic isolates of *Vibrio parahaemolyticus* for isolation of unique antigens followed by the preparation of polyclonal antiserum for developing dot ELISA.
- Development of multivalent vibriosis vaccine : Whole cell killed vaccine prepared from virulent strain of *Vibrio anguillarum* has resulted in significant enhancement of humoral antibody response and protective immunity in the grouper, *Epinephelus malabaricus* compared to the controls. However the protective immunity from whole cell killed vaccine of *Vibrio parahaemolyticus* was not statistically significant and need further trials.

Purification and structural elucidation of purified biomolecules from *Ulva fasciata* and evaluation of immunomodulatory potential

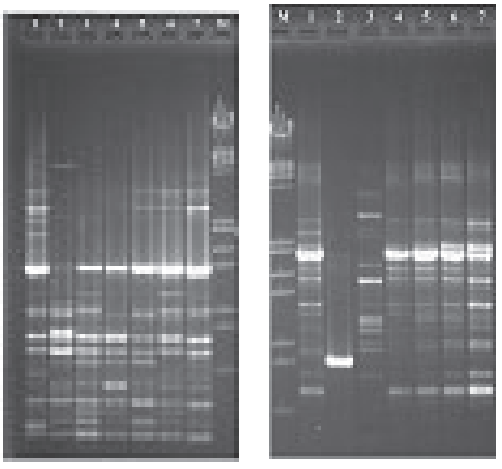
- Biomolecules from *Ulva fasciata* were extracted by different solvents and fractionated into hexane, chloroform, dichloromethane and n butanol fractions.
- HB2b fraction of Hexane-Benzene (60:40%) in PBS (PH - 7) showed the highest antibacterial activity of 18mm against *Vibrio alginolyticus.* Whereas HB5a fraction (Hexane/Benzene -80:20%) exhibited moderate antibacterial effect against *S. aureus, V. fischeri* and *Vibrio alginolyticus* isolates.

Purification and structural elucidation of purified biomolecules from *Hypnea musciformis* and evaluation of immunomodulatory potential

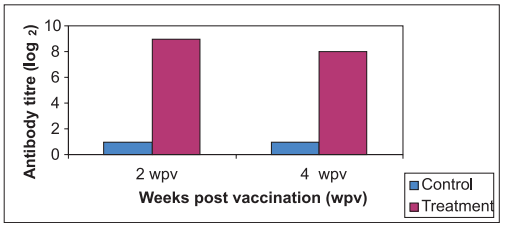
- Column chromatographically purified fractions of *Hypnea musciformis* revealed an array of nonpolar (R_f= 0.85 in 10% dichloromethane in pet ether) to polar compounds (R = 0.15).
- The methanol extract of *H. musciformis* exhibited broad spectrum antibacterial activity.
- Evaluation of immunomodulatory activity potential of feeding extracts of *Hypnea musciformis* for control of disease causing organisms in marine ornamental fishes revealed an increased total hemocyte count from 10th day onwards and increased mean body weight after the 30 day experiment.
- Challenge experiments *in Penaeus monodon* using *Vibrio alginolyticus* revealed that combined dose of 0.95 mg/ml *Hypnea musciformis* extract and 150 mg of Levamisole per Kg body weight at the density of 10^5 and 10^6 cells/ ml, could ensure 100 % survivability.



Arbitrary primed PCR products of *Vibrio parahaemolyticus* field strains

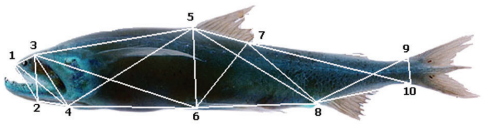


Arbitrary primed PCR products of *A. hydrophila* Plasmid DNA



Antibody titre of *E. malabaricus* immunized with *V. anguillarum* vaccine

PROJECT CODE	**NBFGR - CMFRI/CO1 (Collaborative mode)**
PROJECT TITLE	**Genetic divergence studies in prioritized marine finfish and shellfish species**
SCIENTIST	**P. Jayasankar, A. Gopalakrishnan (NBFGR)** and V.S. Basheer (NBFGR)
CENTRE	Cochin



Truss landmarks of Bombay duck (*Harpadon nehereus*)

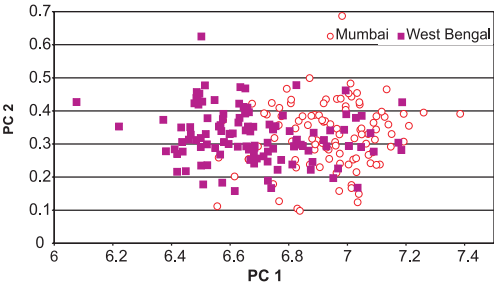
Morphometric analysis of Bombay duck (*Harpadon nehereus*)

Sheared Principal Component Analysis

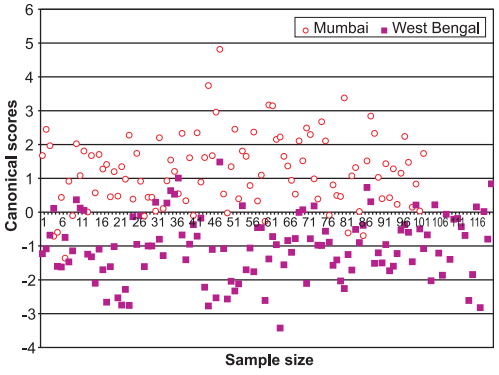
- Principal component analysis of 21 distance measures from 10 landmark points in each fish was carried out. A plot of PC 1 and size-corrected PC 2 indicated horizontal separation of clusters belonging to Mumbai and West Bengal.The cluster points of WestBengal samples were more spread out in comparison with those of Mumbai samples.
- Further, t-test (2 samples assuming equal variances) of PC 1 and size-corrected PC 2 scores between each of the locations showed high significance in the former (d.f. =220, P<0.001) and no significance in the latter (d.f. =220, P>0.5).

Discriminant function analysis

- Discriminant functions of 21 distance measures from 10 landmarks of samples from both centres were analysed using Systat 7.0 software. Classification of functions with respect to the populations was tested using Jackknifed classification method and obtained 82% correct classification in Mumbai samples and 79% in West Bengal samples. The group differences were significantly different (Wilks' lambda, d.f. =21, P<0.0001).
- A perusal of the canonical standardized discriminant functions indicated maximum values in the caudal peduncle including the area behind dorsal fin, which means differences in the samples between two locations are attributed by the distance measures representing this region of fish body.
- The canonical scores of samples from Mumbai and West Bengal were plotted and it shows clear separation of clusters.
- The above results from PCA and Discriminant Function analysis indicate that the morphological differences in the populations of Bombay duck from Mumbai and West Bengal could be size-related but not due to shape variations. Further, the differences are due mainly to the distance measures in the posterior region of fish body behind the dorsal fin.



Sheared principal component analysis of truss landmarks of Bombay duck from 2 locations



Scatter plot of canonical scores of Bombay duck from 2 locations

RAPD analysis of Bombay duck

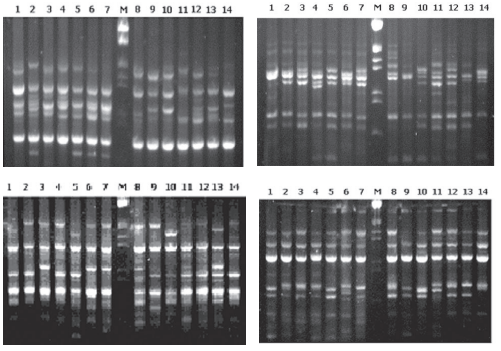
- Genomic DNA was extracted from muscle tissue of Bombay duck samples collected from Mumbai and West Bengal and screened using 5 RAPD primers. Data generated from 4 primers (OPA-07, OPAA-12, OPAC-14 and OPB-08) were used for further analysis and interpretation based on the quality of bands – robustness and reproducibility. A total of 28 samples (14 each from Mumbai and West Bengal) were analysed and the four primers amplified 35 reliable fragments, ranging from 7 (OPB-08) to 11 (OPAA-12).

Table 1. Some of the population genetic data of the two populations generated by 4 primers

Parameter	Mumbai	West Bengal
Gene diversity	0.1924 (±0.2012)	0.2698 (±0.2040)
Genetic similarity	0.733965 (±0.113)	0.61990 (±0.1413)
Shannon Index	0.2882 (±0.2893)	0.3976 (±0.2844)
No of polymorphic loci	19	25
Percentage polymorphism	54.29	71.43

- It is apparent from table above that the samples from West Bengal showed relatively more genetic variation compared to those from Mumbai. Overall G_{ST} and Gene flow of the two populations were 0.2194 and 1.7787, respectively. This may indicate high level of genetic mixing of the fishes from the two regions. Results of 1-way ANOVA of intrapopulation genetic distance values are furnished below:

- The present genetic analysis of Bombay duck samples from Mumbai (Northwest coast) and West Bengal (Northeast coast) clearly shows high genetic variability, especially in the latter. Though a low G_{ST} value in combination with high gene flow was observed, the data indicates sufficient genetic separation of the two populations. In order to establish them as two distinct genetic stocks, more RAPD primers have to be screened on more sample DNAs from both locations.



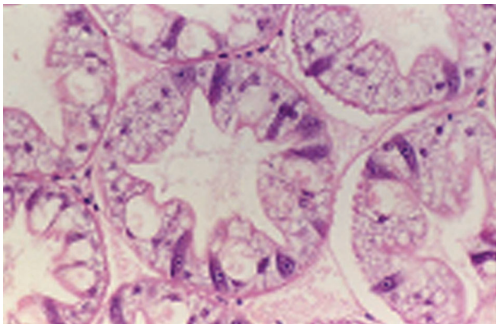
RAPD fingerprints of Bombay duck generated by OPA-07 (A), OPAA-12 (B), OPAC-14 (C) and OPB-08 (D). Lanes 1-7, fish from Mumbai; lanes 8-14, fish from West Bengal; lane M, DNA size marker.

DNA analysis of lobsters

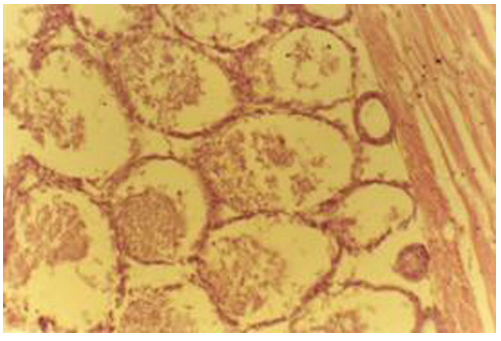
- Samples of *Panulirus homarus, P. versicolor* and *P. ornatus* were collected from Vizhinjam and West Bengal. Standardized isolation of genomic DNA from the tip of antennae, a significant step considering the fact that there is no need to purchase the entire animal (which is very expensive) and the trader won't mind sparing samples free of cost for research purpose. Morphological identification of the species was confirmed on the field using standard taxonomic keys as well as later in the laboratory by scrutinizing the photos. PCR of genomic DNA of samples by RAPD is in progress.

Sponsored Projects

FUNDING AGENCY	**ICAR-AP CESS NETWORK PROJECT**
PROJECT TITLE	**Investigation on 'loose shell syndrome' among farmed tiger shrimp, *Penaeus monodon***
SCIENTIST	**K.K.Vijayan**
CENTRE	Initially as PI at CIBA, and continuing at CMFRI, Kochi as Co-PI



Histology of hepatopancreas from healthy shrimp



Histopathology of the HP collected from the LSS affected shrimp with severe atrophy and necrosis

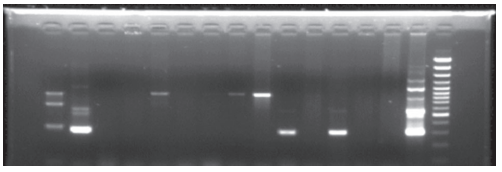
- The project was sanctioned on 27th April 2005 at CIBA, Chennai, and subsequently 2 SRF's have been appointed. The project was envisaged to monitor the incidence, prevalence and economic implications of 'loose shell syndrome (LSS)' among the farmed *P. monodon* crop from Andhra Pradesh (AP) and Tamilnadu (TN), and other maritime states. The main objectives are:
- To investigate the causative factors involved in the 'loose shell syndrome'
- To study the epizootiology of the LSS and standardize diagnostics for LSS
- To draw management interventions for the control of LSS
- Sampling areas was identified in the states of Tamilanadu and Andhrapradesh, Accordingly the first sampling was done from the LSS affected sites of Marakanam, TN and Gudur, AP.
- Affected shrimp had loose exoskeleton, stiff rostrum, and often reddish discoloration. Shrimp had poor escape reflux and were anorexic. Microscopic observation revealed moderate level of ciliate protozoan (*Zoothamnium* sp, and *Vorticella* sp) fouling on the gills.
- The hepatopancreas appeared shrunken and discoloured in the LSS affected shrimp, while among the healthy shrimp the midgut gland was normal in colour and size. Histopathological observation on the LSS affected HP revealed severe atrophy, and the hepatopancreatic cells were necrotic nature.
- Microbiological studies on the haemolymph showed the presence of *Vibrio parahaemolyticus*, *Moraxella* spp, and *Flavobacterium* spp. These isolates were sensitive to oxytetracycline and gentamycin, and resistant to nitrofurazone, chloramphenicol and kanamycin. However, challenging studies using the above bacterial strains did not produce the typical LSS.
- The affected shrimp showed etiological characteristics resembling Necrotizing Hepatopancreatitis (NHP), such as lethargy, reduced growth, increased food conversion ratios, anorexia, soft shells. Hence screening of the NHP was conducted using PCR developed for the diagnostics of NHP (Loy et al., 1996). Interestingly, two samples tested positive for NHP.

FUNDING AGENCY	**NACA-ICAR International Project**
PROJECT TITLE	**Application of PCR for improved shrimp health management in the Asian region**
SCIENTISTS	**K.K.Vijayan**
CENTRE	(Indian Component Initially as PI at CIBA, Chennai. Continuing at CMFRI, Cochin as Co-PI.

- A regional shrimp health project titled ***"Application of PCR for improved shrimp health management in the Asian region"*** is being implemented since January 2005 in India. Key partners for the regional project include Network of Aquaculture Centres in Asia-Pacific-Bangkok (NACA); Marine Products Export Development Authority (MPEDA)-Kochi; Australian Center for International Agricultural Research (ACIAR), Council of Scientific and Industrial Research Organisation (CSIRO) and AusVet Services Australia; Mangalore Fisheries College in India; Mahidol University, BIOTEC, Thailand and Central Institute of Brackishwater Aquaculture (CIBA-ICAR), Chennai. After the shifting of the to CMFRI, associated with the project as Co-PI, at CMFRI, Kochi.

Studies on the WSSV epidemiology by *nested* PCR

- In order to study the epidemiology of the WSSV from the selected ICAR-NACA project sites of Mogalthur, Andhra Pradesh (AP), shrimp samples were collected at the time of stocking the postlarvae (PL) and during the crop period, and stored in alcohol fixative for PCR analysis. Samples included, representative samples of *P. monodon* postlarvae (PL) used for stocking, juvenile shrimp after 30 days of culture, pleopods collected from Midcrop subadults, pleopds from shrimp collected during disease outbreaks, reservoir hosts such as wild crabs and shrimps. Samples of PLs, shrimp juveniles, midcrop samples and samples of emergency harvests were analysed for WSSV using nested PCR. Only 4-6% samples tested for WSSV among PLs and juveniles, and surprisingly none of the emergency harvested samples tested positive for WSSV. Further analysis is underway to draw the disease development process of WSSV infection during the farming of tiger shrimp from AP.



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Screening of shrimp samples collected from *P. monodon* crop from the ICAR-NACA study site, Mogalthur, Andhra Pradesh. Lanes 1-14, samples (2, 10, and 12 are WSSV positive); Lane, 16 molecular marker; Lane, 15 positive control, Lane, 14 neagtive control

FUNDING AGENCY	**ICAR-AP CESS FUND**
PROJECT TITLE	**Development of pro-active disease control strategies for sustainable shrimp farming using marine algal metabolites**
SCIENTIST	**A.P. Lipton**
CENTRE	Vizhinjam

Isolation of marine bioactive compounds from the macroalga, *Hypnea musciformis* and screening their antibiotic activity against fish and shellfish pathogenic bacteria

- The fractionated extracts of *Hypnea musciformis* showed an average 15 mm diameter inhibition zones towards the tested pathogenic bacterial strains of *Staphylococcus aureus* and *Vibrio alginolyticus*. Among the fractionated extracts, all the Hexane (100%) samples exhibited minimum activity towards *V. fischeri*, *V. alginolyticus*, *Staphylococcus aureus* and *S. marcescens.* HB2b fraction of Hexane-Benzene (60:40%) in PBS (PH - 7) showed the highest antibacterial activity of more than 18 mm diameter inhibition zone against *Vibrio*

alginolyticus. The HB5a fraction (Hexane/Benzene -80:20%) also exhibited moderate antibacterial effect against pathogenic isolates of *S. aureus*, *V. fischeri* and *Vibrio alginolyticus*.

Evaluation of immunomodulatory activity potential of extracts of *Hypnea musciformis* for control of disease causing organisms in shrimps (*Penaeus monodon*)

- The commercial pelleted shrimp grower feed No. 4 (C P feeds, Cochin) was top coated with a combined dose of 0.95 mg/ml *Hypnea musciformis* extract and 150 mg of Levamisole per kg body weight.
- Increased total hemocyte count (THC) in *P. monodon* was recorded compared to the control groups from 10^{th} day onwards with more granulocytes. The Average Body Weight (ABW) increased among the experimental shrimps after 30^{th} day of experiment.
- The results of bath challenge experiments using *Vibrio alginolyticus* revealed that at the densities of 10^5 and 10^6 cells/ml, no mortality was noted in the experimental shrimps.

Technology Assessed & Transferred

Keerthi Kudumbasree group at Moothakunnam suspending a seeded mussel rope

Mussel farming in new areas

Mussel farming has been taken up in a big way in the backwater areas of Munambam estuary. Molluscan Fisheries Division conducted 3 training programmes in collaboration with Brackish Water Fish Farmer's Development Agency (BFFDA) for the fishermen of this area. Three farms are at Kottuvallikad and 8 at Moothakunnam. All the farms are of 5m x 5m size and 50 ropes of 1m-seeded length are tied to these racks. BFFDA, Ernakulam gave financial support for all these farmers belonging to 'Kudumbasree' groups to take up mussel farming in the estuary. Molluscan Fisheries Division of the Institute is monitoring environmental characters and mussel production of the farms. About 4-5t production is expected by April-May period.

Special Infrastructure Development

- A new national facility 'Marine Biodiversity Museum" has been created at Headquarters, CMFRI, Cochin realizing the importance of a National Referral Museum with computerized database. The facility was declaired opened by PadmaVibhushan Prof. M.S. Swaminathan, Chairman, National Commission of Farmers, Government of India on 4th February, 2006.

  This Museum houses 135 species under 272 families and 64 orders of the phyla Porifera, Colenterata, Mollusca, Arthropoda, Echinodermata and Chordata in addition to 53 species of marine algae. The collections housed in this Museum are easily accessed by both public and research students.

- The underwater video recording system Titan ROV III made in Australia by M/s. Deep Scenes has been installed in RV Cadalmin IV of the Tuticorin Research Centre.

- The HQ provided the Mangalore Research Centre with a Visualizer during this period.

- Newly constructed building at South Beach Road, Tuticorin was occupied on 05.12.2005.

National facility 'Marine Bio-diversity Museum' being declared opened by Dr. M. S. Swaminathan

Training in Mariculture

Front-line demonstrations and training for trainers / farmers in mariculture technologies

- Frontline demonstrations and training programmes in association with State fisheries departments and other aquaculture development agencies were conducted as a part of the project. In central Kerala 16 mussel farms including an open sea raft were set up stocking 430 mussel ropes and 18 oyster farms where 5750 oyster rens were stocked by farmers. In north Kerala more than 650 coastal fishers benefited from the interactive sessions held with farmers and nearly 300 fishers have initiated mussel farming this year. Integrated farming of seaweed *K.alvarezii* with mussel/shrimp was also taken up by farmers with the scientific support from the project team members.

Distribution of seed material of *Kappaphycus alvarezii* to members of Green Mussel Farmer's Society, Padanna

Schedule of training in mussel, oyster and seaweed culture offered to farmers in Kerala

Place	Period	Technology disseminated	Beneficiaries	Remarks
Central Kerala (Cherai, Puthenvelikkara, Moothakunnam, Narakkal, Kottuvallikkad, Edakochi)	October to January	Mussel farming	570 (Farmers and SHG'S)	Scientific support given in fabrication of grow out structures, seeding and harvesting in association with BFFDA
Central Kerala (Cherai, Puthenvelikkara, Kottuvallikkad, Moothakunnam)	October and December	Oyster farming	330 (Farmers and SHG'S)	Scientific support given in setting up oyster farms and ren preparation
Kozhikode and Kannur	October to January	Mussel and Oyster farming	300	
Malappuram	October	Oyster farming Remote setting	150 (Farmers and SHG'S)	Remote set spat given to mussel farmers
Kasargod	December	Harmful Algal Blooms and EIA of farming sites	250 (farmers and SHG'S)	Advanced training and interaction mussel farmers
Pulicat Lake	June, July and August	Mussel farming	100 (fishermen affected by Tsunami	In association with Aquaculture Foundation of India and NGO
Central Kerala (Narakkal, Sattar Island)	December - January	Farming seaweed *Kappaphycus alvarezii*	82 (farmers and SHG'S)	
Cochin	January - February	Extraction & characterization of carrageenan & natural pigments from *Kappaphycus* sp.	Students	
Kasargod	December	Farming of seaweed *Kappaphycus alvarezii*	100 mussel farmers	In association with Green Mussel Farmer's Society Padanna (One Kg of seed material of *K. alvarezii* was supplied to each farmer for farming)

Education & Training

Postgraduate Programme In Mariculture

Ph. D. Programme

The following Senior Research Fellows of the regular stream and sponsored projects of the Institute were awarded Ph.D. Degrees

Name of student	Name of Sup. Teacher	Title of Thesis	University
Anikuttan, K.K.	Dr. K.C. George	Pathology of aflatoxicosis and heavy metal toxicity in pearl spot *Etroplus suratensis* (Bloch)	CIFE
Binu Varghese	Dr. R. Paul Raj	Nutritional studies in sebae anemonefish, *Amphiprion sebae* Bleeker 1853, with special reference to protein and lipid requirements	CIFE
Juliet Joseph	Dr. R. Sathiadhas	Economic analysis of externalities in coastal mariculture	CIFE
Anikumari, N.P.	Dr. K. Sunilkumar Mohamed	Studies on the use of probiotics in the larval rearing of the shrimp *Penaeus monodon* (Fabricius, 1798)	CIFE
Ajitha, S.	Dr. V. Chandrika	Role of *Bacillus* and *Lactobacillus* from marine environment for sustainable aquaculture practices	CUSAT
Gopakumar, S.D.	Dr.C.P. Gopinathan	Nutritional enrichment of the rotifer *Brachionus rotundiformis* (Tschugunoff) for the rearing of marine finfish and shrimp larvae	CUSAT
Dalia Susan Vargis	Dr. N.G.K. Pillai	Macrobenthos of Minicoy Island, Lakshadweep	CUSAT
Latha, M.M.	Dr. (Mrs) V. Chandrika	Ecophysiology of Nontuberculous Mycobacteria from marine aquaculture ponds	CUSAT
Gijo Ittoop	Dr. K.C. George	Hemolymph factors responsible for defence reactions against pollutants and bacteria, *Vibrio alginolyticus*, in the Indian edible oyster, *Crassostrea madrasensis* (Preston)	Kerala
Jyothi V. Mallia	Dr. P. Muthiah	Induction and evaluation of triploidy in *Crassostrea madrasensis* (Preston)	M.S. University

- Thirty Ph.D. regular students and SRFs (Six Ph.D. students under CIFE, 6 students under CUSAT and 18 students under Mangalore University) are currently progressing with their research/course work.

M.F.Sc. (MC) Programme

- Five students have been awarded degree by CIFE (Deemed University) in August, 2005.
- Nine M.F.Sc. (MC) students are currently progressing with their course/research work

Field Experience Training of ARS Probationers from NAARM

- Six Agricultural Research Service Probationers of 79th FOCARS from NAARM underwent FET at CMFRI for 21 days from 8th to 28th September 2005.

Krishi Vigyan Kendra

Krishi Vigyan Kendras (KVKs) serve as a catalyst in the research-extension-farmer interface. The KVKs are the district level organizations having the mandate of reaching all the major categories of rural areas like the farmers, farmwomen, youth and the landless population. In addition the extension functionaries of different departments are refreshed with the latest advancements in the respective areas. Generating location-specific technological options for solving farm related problems and popularizing them through well planned and publicized demonstrations have created a niche for KVKs as a front line extension system. The major impact of KVKs is in the area of vocational education and self employment generation. The KVKs have responded to the needs of different clientele groups by organizing short-term, skill oriented training programmes.

1. Training programmes conducted:

a. Practicing farmers (On campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Brackishwater fish farming	1	14	6	20	6
Home Science	Value addition to shrimp	1	-	12	12	-
Total (a)		2	14	18	32	6

b. Practicing farmers (Off campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Brackishwater fish farming Shrimp farming Crab farming and fattening	112	132233	7112	202345	5-8
Horticulture	Integrated pest and disease management in coconut Integrated pest and disease management in coconut Integrated nutrient management in coconut cultivation, jasmine cultivation	12111	--88-	1540121720	1540202520	12-17-5
Home Science	Value addition to fruit	1	-	25	25	-
Total (b)		11	84	149	233	47

c. Rural Youth (On campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Crab farming and fattening Seaweed farming	11	94	813	1717	13
Horticulture	Mushroom Cultivation Mushroom spawn production	37	2083	6162	81145	1024
Home Science	Value addition to fish Value addition to mushroom Toilet soap making	115	2161	182184	203785	4
Total (c)		19	135	267	402	51

d. Rural Youth (Off campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Crab farming and fattening	4	45	45	90	4
	Selective breeding of freshwater ornamental fish	5	41	53	94	-
	Selective breeding of freshwater fish	2	34	2	36	-
	Freshwater fish farming	4	54	26	80	-
	Freshwater ornamental fish culture	4	32	48	80	1
	Brackishwater fish farming	1	14	6	20	-
	Shrimp farming	1	6	14	20	1
Horticulture	Jasmine cultivation	5	29	70	99	-
	Mushroom Cultivation	2	14	26	40	2
	Vermicomposting	3	22	38	60	-
Home Science	Value addition to fish	13	8	252	260	41
	Value addition to fruits	11	-	224	224	13
	Toilet soap making	4	-	85	85	21
Total (d)		59	229	889	1188	83

e. Extension workers

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Home Science	Value addition to shrimp	1	1	19	20	2
Total (e)	1	1	19	20	2	

f. Extension workers

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Freshwater fish farming	2	15	25	40	5
Horticulture	Indoor gardening and floral art	1	6	24	30	-
	Capacity building for women Agricultural Officers	1	-	30	30	-
	Seedling production	1	11	19	30	-
	Nursery management and propagation	1	13	17	30	-
	Agricultural technology upgradation	1	12	18	30	2
Total (f)		**7**	**57**	**133**	**190**	**7**
GRAND TOTAL (a+b+c+d+e+f)		**99**	**591**	**1474**	**2065**	**196**

2. Conducting Seminars /Mahila meet /Farmers meet etc.

Sl.No.	Date	Nature of activity	Place
1.	9-5-2005	Awareness programme on mushroom cultivation	K.E.M. High School, Alangad
2.	16-5-2005	Farmers meet on mushroom cultivation	Krishi Bhavan, Thiruvaniyoor
3.	21-5-2005	Farmers meet on Jasmine cultivation	Krishi Bhavan, Aikkaranad
4.	28-5-2005	Farmers meet on Jasmine cultivation	Krishi Bhavan, Mazhuvanoor
5.	18-6-2005	Awareness programme on mushroom cultivation	Gregorious Beththlehem hall, Mulamthuruthy
6.	1-7-2005	Mahila meet on "Drudgery reduction in cooking"	Village office, Varapuzha
7.	17-8-2005	Field day on Mushroom cultivation in connection with "Karshagha Dinam"	Krishi Bhavan, Eloor
8.	17-8-2005	Farmers meet on "Fresh water Ornamental fish farming" in connection with "Karshagha Dinam"	Krishi Bhavan, Kunnathunadu
9.	18-8-2005	Farmers meet on Mushroom cultivation	Office of the Command Area Development Authority, Perumbavoor
10.	22-8-2005	Farmers meet on mushroom cultivation	Office of the Assistant Director of Agriculture, Muvattupuzha
11.	23-8-2005	Farmers meet on mushroom cultivation	Office of the Assistant Director of Agriculture, Choornikara
12.	25-8-2005	Farmers meet on Freshwater ornamental fish culture	Farm of Shri C.M. Hamsa, Kunjunnikkara.
13.	26-8-2006	Mahila meet on "Empowerment of rural women"	SN Puram, Aluva
14.	30-8-2005	Farmers meet on Mushroom cultivation	Krishi Bhavan, Perumbavoor
15.	12-9-2005	Farmers meet on Mushroom cultivation	Office of the Assistant Director of Agriculture, Paravoor
16.	10-11-2005	Farmers meet on Organic farming	Mariyalayam Social Organisation, Panankad
17.	15-11-2005	Farmers meet on Shrimp farming	Cooperative Bank Auditorium, Malipuram
18.	8-12-2005	Farmers meet on Vermi composting	Krishi Bhavan, Thuravur
19.	19-12-2005	Farmers meet on Mushroom cultivation	Krishi Bhavan, Poothrikka
20.	21-12-2005	Farmers meet on Mushroom cultivation	Krishi Bhavan, Pazhankanad
21.	22-12-2005	Mahila meet on "Drudgery reduction in cooking"	Block Panchayat office, Palluruthy
22.	22-12-2005	Farmers meet on Jasmine cultivation	Krishi Bhavan, Poothrikka
23.	23-12-2005	Farmers meet on Mushroom cultivation	Krishi Bhavan, Kizhambalam
24.	27-12-2005	Farmers meet on Vermi composting	Nehru Yuva Kendra, Karthikapilly
25.	20-1-2006	Farmers meet on Mushroom cultivation	Gramma panchayat, Ponnarimangalam
26.	23-1-2006	Farmers meet on Mushroom cultivation	Krishi Bhavan, Varapuzha
27.	4-2-2006	Farmers meet on Jasmine cultivation	Krishi Bhavan, Avoli
28.	6.2.2006	Farmers meet on Jasmine cultivation	Krishi Bhavan, Edakkattuvayal
29.	8-2-2006	Mahila meet on "Empowerment of rural women"	Gramma panchayat, Mazhuvanoor
30.	14-2-2006	Mahila meet on "Empowerment of rural women"	Gramma panchayat, Elamkunnapuzha
31.	14-2-2006	Farmers meet on Mushroom cultivation	Krishi Bhavan,Senthamangalam
32.	20-2-2006	Farmers meet on Vermi composting	Krishi Bhavan, Maradu
33.	21-2-2006	Farmers meet on Mushroom cultivation	Krishi Bhavan, Vengola
34.	27-2-2006	Farmers meet on Mushroom cultivation	Krishi Bhavan, Assamanoor
		Conduct of Mahila meet	
35.	7-3-2006	Farmers meet on Mushroom cultivation	Department of Social Welfare, Ernakulam
36.	18-3-2006	Farmers meet on Mushroom cultivation	Offfice of the Soil Conservation, Valambur
37.	22-3-2006	Farmers meet on Mushroom cultivation	Central Board for Workers Education, Ernakulam
38.	25-3-2006	Farmers meet on Mushroom cultivation	Offfice of the Soil Conservation, Ambalappady

3. Conduct of science camp for school students.

Two Science camps for the Vocational Higher Secondary School students of Government High School, Kadamakudy and Narakkal on "Aquafarming" and one for Vocational Higher Secondary School students, Maradu on "Mushroom cultivation and spawn production. Practical classes were conducted during these camps.

4. Extension activities

4.1 Front line demonstrations conducted (FLD)

FLD on the following interventions were implemented during the period under report namely i. Homogeneous stocking and feed management in mullets; ii. Popularization of organics based nutrient management in coconut; and iii. Management of red palm weevil in coconut.

4.2 On Farm Testing (OFT)

OFT on the following interventions were implemented during the period under report namely i. Testing of stocking density and feed management in monoculture of crab; and ii. Integrated pest management in coconut.

5. Establishment of income generating units

5.1 Training and technical guidance was given to Shri P.F. Mani, Padinjarekkoot House, Nayarambalam on farming of tiger shrimp *Penaeus monodon*. He has started farming in an area of 1.08 ha as a self employment. He was able to harvest 570 kg of tiger shrimp.

5.2 Based on the training received from KVK on "Mushroom spawn production and spawn production" Shri V.M. Mohamed, Vattakavil, Onnukal, Kothamangalam started a small unit to produce 5 kg of milky mushroom per day to supplement his income.

5.3 Shri K. Suresh, Kannimoolath House, Vengola attended the training programme conducted by the KVK on "Jasmine cultivation". He started cultivating 500 Jasmine plants. An average production of 120kg/month is obtained.

6. Project feasibility report

6.1 Project reports on vermicomposting, jasmine cultivation and mushroom cultivation was prepared and given to Department of Social Welfare, Ernakulam to implement the scheme in the homes run by the department for the physically handicapped women.

6.2 A project report for the cultivation of mushroom was given to Shri K.C. Kora, Cherukadakunnal, Kizhumuri, Ramamangalam for availing loan from a scheduled bank for the establishment of a unit to produce 25 kg of mushroom per day.

OFT on crab farming in the farmers field

Shri P.F. Mani harvesting shrimp from his farm

Shri V.M. Mohamed in his mushroom unit

Shri Suresh and his wife in the jasmine farm

Awards & Recognitions

Dr. (Mrs.) Josileen Jose receiving the award from Dr. Mangala Rai, Director General, ICAR, New Delhi

Dr. Vipinkumar V. P. receiving the "Young Scientist Award" of Indian Society of Extension Education (ISEE) from Dr. G. Trivedi, International Expert in Extension Education

Dr.N.G.K.Pillai,HOD, Pelagic Fisheries Division and Dr.K.Madhu, Senior Scientist receiving the prize from Shri.Dominic Presentation, Hon.Minister of Fisheries, Govt.of Kerala.

Dr. (Mrs.) Josileen Jose, Senior Scientist bagged the first Professor T.J. Pandian and Professor A.J. Matty Award 2005 instituted by the Indian Branch of Asian Fisheries Society for her contribution to the development of hatchery technology of the Blue swimmer crab, *Portunus pelagicus*.

Dr. Vipinkumar, V.P., Scientist (SS) of SEETT Division of CMFRI, Cochin has won the '***Young Scientist Award***' and '***Best Paper Presentation Award***' in the National Seminar on "Green to Evergreen : Challenges to Extension Education" organized by Indian Society of Extension Education (ISEE) at Indian Agricultural Research Institute (IARI), New Delhi from 15th to 17th December 2005. The awards were presented by Dr. G. Trivedi, the international expert in extension education in the presence of Dr. R. Parshad, the Assistant Director General (Agrl. Extension), ICAR & President of the ISEE.

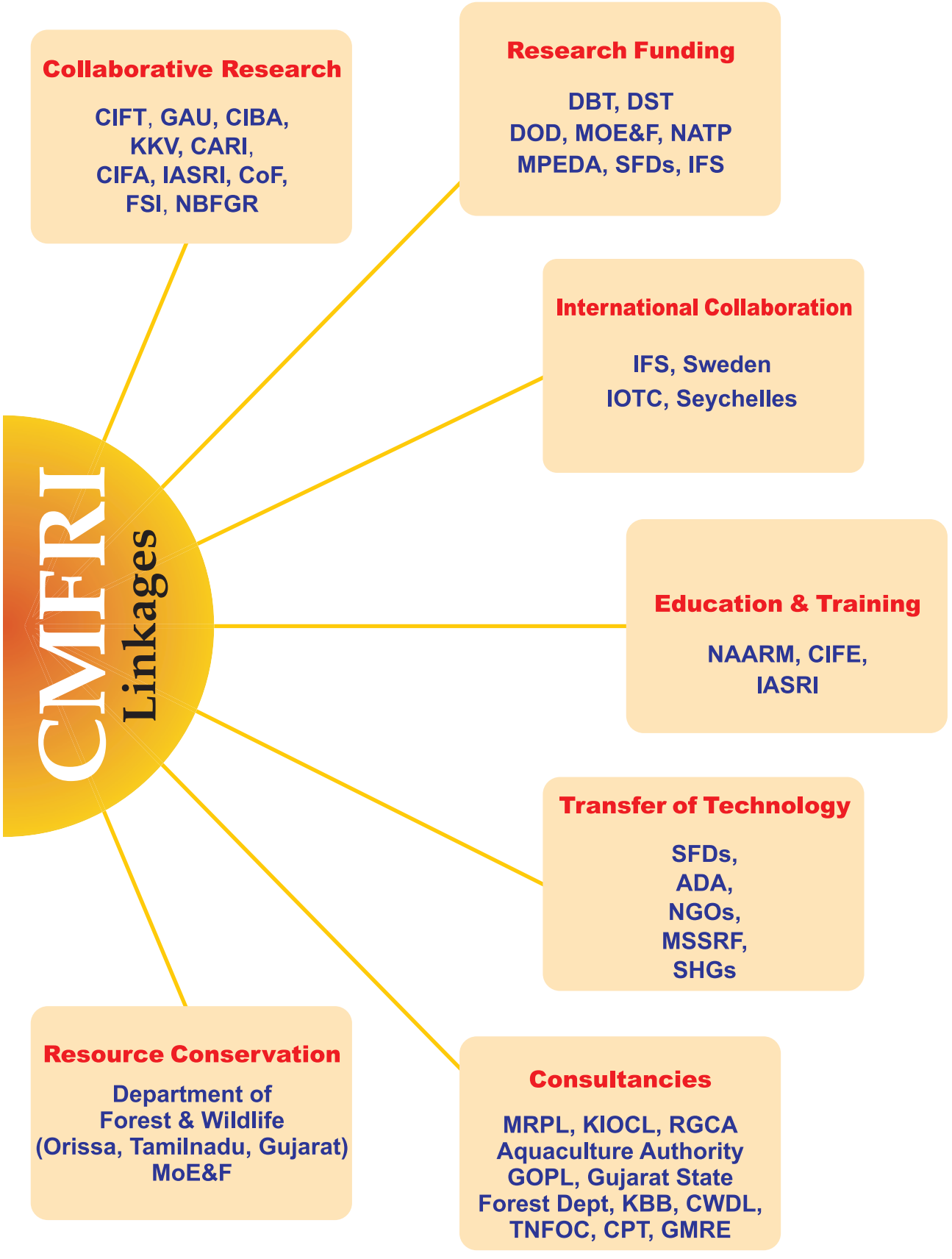
Shri K. Vijayakumaran, Scientist (SG) Visakhapatnam Regional Centre of CMFRI won the best paper award for the year 2004 instituted by the Society of Fishing Technologists for his paper entitled "A simple model for predicting upwelling status along Visakhapatnam coast".

Dr. George J.P., Principal Scientist received the best scientific paper award in Hindi of Central Secretariat Hindi Parishad, New Delhi from Shri Sriprakash Jaiswal, Hon'ble Minister for States, Home Affairs on 18-11-2005 at New Delhi for his paper entitled *Mangrove Biodiversity, conservation and management in India*. The award included citation, cash prize, shield and angavasthra.

A poster by Dr. P.K. Krishnakumar and team entitled "Impact of altered river flow on the Biogeochemistry and productivity of the seas along the east and west coast of India" was adjudged as one of the three Best Poster Papers – 2005 at the 7th Indian Fisheries Forum at Bangalore.

The stall set up by Vizhinjam Research Centre of CMFRI received the prize for best Marine stall in the Aquashow held at Thiruvananthapuram from 9 to 18th September, 2005.

The marine aquarium stall set up by CMFRI, Kochi has been selected as the "Runner up in the Best Ornamental Exhibitor" and the "Best Exhibitor of Marine Fish Ornamental" in the India International Aquashow 2006 competition held at Jawaharlal Nehru International Stadium, Kochi from 2nd to 7th February 2006.


CMFRI
Linkages
Collaborative Research
CIFT, GAU, CIBA,
KKV, CARI,
CIFA, IASRI, CoF,
FSI, NBFGR
Research Funding
DBT, DST
DOD, MOE&F, NATP
MPEDA, SFDs, IFS
International Collaboration
IFS, Sweden
IOTC, Seychelles
Education & Training
NAARM, CIFE,
IASRI
Transfer of Technology
SFDs,
ADA,
NGOs,
MSSRF,
SHGs
Consultancies
MRPL, KIOCL, RGCA
Aquaculture Authority
GOPL, Gujarat State
Forest Dept, KBB, CWDL,
TNFOC, CPT, GMRE
Resource Conservation
Department of
Forest & Wildlife
(Orissa, Tamilnadu, Gujarat)
MoE&F

Publications

- Indian Journal of Fisheries
- Special Publication No. 89
- Special Publication No. 86
- Marine Fisheries Information Service
- Newsletter
- Evolution of Fisheries and Aquaculture in India
- Special Publication (Hindi) No. 90
- Matsyagandha
- Bibliography
- Extension pamphlets

Journals (peer reviewed)

ABDUSSAMAD, E.M., P.P. PILLAI, H..M. KASIM AND T.S. BALASUBRAMANIAN. 2005. Fishery and population characteristics of coastal Tunas at Tuticorin. *J. mar. biol. Ass. India*, 47 (1): 50-56.

ALLAF NAVERIAN, H. AND P. VIJAYAGOPAL. 2005. Effects of different levels of protein, energy and their interaction on growth of Indian white shrimp (*Fenneropenaeus indicus*) of different sizes. *Iranian Journal of Fisheries Sciences*, 4(2): 59-80.

ASHA, P.S. AND P. MUTHIAH. 2005. Effect of temperature, salinity and pH on the larval growth, survival and development of the sea cucumber *Holothuria spinifera* Theel. *Aquaculture*, 250 (3&4): 823-829.

ASHA, P.S. AND P. MUTHIAH. 2006. Effect of single and combined microalgae on the larval growth, survival and development of the commercial sea cucumber *Holothuria spinifera* Theel. *Aquaculture Research*, 37: 113-118.

DHANWANTHARI EMMADI, AKIKO IWAHORI, IKUO HIRONO AND TAKASHI AOKI. 2005. cDNA microarray analysis of interleukin-1ß-induced Japanese flounder, *Paralichthys olivaceus* kidney cells. *Fisheries Science*: Vol. 71, 519-530.

DINESHBABU, A.P. 2005. Growth of kiddy shrimp, *Parapenaeopsis stylifera* (H. Milne Edwards, 1837) along Saurashtra coast of India, *Indian J. Fish.*, 52(2): 165-170.

GIJO ITTOOP, K.C. GEORGE, RANI MARY GEORGE, K.S. SOBHANA, N.K. SANIL AND P. C. NISHA. 2005. Effect of salinity on the hemocyte profile and phagocytosis in the Indian edible oyster, *Crassostrea madrasensis* (Preston). 2005. *J. mar. biol. Ass. India*, 47(1) : 31-35.

KALADHARAN, P., D.PREMA, K.K. VALSALA, K.S.LEELABHAI AND M. RAJAGOPALAN. 2005. Trends in heavy metal concentration in sediment, finfishes and shell fishes of inshore waters of Cochin, southwest coast of India. *J. mar. biol. Ass. India*, 47(1): 1-7.

KALADHARAN, P. AND T.S. VELAYUDHAN. 2005. GABA from *Hypnea valentiae* and its effect on larval settlement of *Perna viridis*. *Seaweed Res. & Utiln.* 27: 8-14.

KARUPPASWAMY, P.K. AND N.G. MENON. 2005. Penaeoid and sergestoid shrimps from the deep scattering layers (DSL) in the Arabian sea. *J. mar. biol. Ass. India*, 47 (1): 101-105.

KRUPESHA SHARMA, S.R., SEEMA JAYAPRAKASH AND E.V. RADHAKRISHNAN. 2005. Sub-lethal toxicity of copper and serum phenoloxidase activity pattern in the Indian white shrimp *Fenneropenaeus indicus* (H. Milne Edwards, 1837); Effects of individual metals. *J. immunol. Immunopathol.*, 7(1): 37-41.

LAXMILATHA, P., T.S. VELAYUDHAN, V. KRIPA, JENNY SHARMA AND P.S. ALLOYCIOUS. 2005. Biology of the black clam *Villorita cyprinoids* (Gray) in the backwaters of Vembanad Lake. *Indian J. Fish.*, 52(3): 361-366.

MANOJKUMAR, P.P. 2005. Fishery of the spiny cheek grouper, *Epinephelus diacanthus* (Valenciennes) off Calicut along the Malabar coast. *J. mar. biol. Ass. India*, 47 (1): 63-69.

MANOJKUMAR, P.P. 2005. Maturation and spawning of *Decapterus russelli* (Ruppell, 1830) along the Malabar coast. *Indian J. Fish.*, 52 (2): 171-178.

MANOJKUMAR, P.P and S. SIVAKAMI. 2005. Fishery of lizardfishes off Veraval with stock assessment of *Saurida tumbil* (Bloch). *Indian J. Fish.*, 52 (3): 323-329.

MOHAMED, K.S., V. KRIPA, T.S. VELAYUDHAN AND K.K. APPUKUTTAN. 2006. Growth and biometric relationships of the pearl oyster *Pinctada fucata* (Gould) on transplanting from Gulf of Mannar to Arabian Sea. *Aquaculture Research*, 37(7): 725-743.

MOHAMED, K.S., V. KRIPA, P. RADHAKRISHNAN, M. JOSEPH, P.S. ALLOYCIOUS, T.S. VELAYUDHAN AND K.K. APPUKUTTAN. 2005. Design and development of a semi-automatic seeder for seeding mussels. *J. mar. biol. Ass. India*, 47 (2): 207 – 209.

NANDAKUMAR, G., E.V.RADHAKRISHNAN, K. CHELLAPPAN AND P.K. BABY. 2005. Shrimp fishery by minitrawling along Alleppey coast, Kerala. *J. mar. biol. Ass. India*, 47(2): 160-165.

PRADEEP KATIHA, J.K. JENA, N.G.K. PILLAI, CHINMOY CHAKRABORTY AND MADAN MOHAN DEY. 2005. Inland aquaculture in India: Past trend, present status and future prospects. *Aquaculture Economics & Management*, 9: 237-264.

RADHAKRISHNAN, E.V., V.D. DESHMUKH, MARY K. MANISSERI, M. RAJAMANI, JOE K.KIZHAKUDAN AND R. THANGARAJA. 2005. Status of the major lobster fisheries in India. *New Zealand Journal of Marine and Freshwater Research*, 79: 723-732.

RAJAMANI, M., S. ASOK KUMAR AND S. VIMALA MAHARAJAN. 2005. Production of cysts and biomass of the exotic species of brine shrimp, *Artemia franscicana* (Kellog) in out-door culture system. *Indian J. Fish*., 52 (1): 61-71.

RAJENDRAN, K.V., K.K. VIJAYAN, T.C. SANTIAGO AND J.S.RAJAN. 2005. White spot syndrome virus (WSSV) infection in tiger shrimp *Penaeus monodon:* A non-lethal histological rapid diagnostic method using paraffin and frozen sections. *Aquaculture International*, 13:341-349.

REKHA J. NAIR. 2004. Studies on the silverbelly fishery of Palk Bay and Gulf of Mannar with a note on the growth parameters of *Leiognathus jonesi*, James, 1967. *Indian J. Fish*. 52 (2):189-195.

REKHA J. NAIR. 2004. Note on a rare coral fish *Cheilinus undulatus J. mar. biol. Ass. India*, 46 (2): 234-236.

SATHIADHAS. R. AND FEMEENA HASSAN. 2005. Empowerment of women involved in clam fisheries of Kerala- A case study. *Indian Journal of Social Research*, 46(1) : 39-48.

SELVIN, J., A.J. HUXLEY AND A.P. LIPTON. 2005. Pathogenicity, antibiogram and bio-chemical characteristics of luminescent *Vibrio harveyi* associated with 'black shell disease' of *Penaeus monodon*. *Fishery Technology*. 42(2): 191-196.

SIVADAS, M. AND A. ANASUKOYA. 2005. On the fishery and some aspects of the biology of dogtooth tuna, *Gymnosarda unicolor* (Rupell) from Minicoy, Lakshadweep. *J. mar. biol. Ass. India.* 47 (1) : 111-113.

THAMBIRAJ, S. AND A.P. LIPTON. 2005. Susceptibility of *Vibrio* sp and *Penicillium citrinum* isolated from infected Seahorse, *Hippocampus kuda* towards antibiotic, antiseptic and marine secondary metabolites. *Journal of Theoretical and Experimental Biology*, 2(1): 35-40.

THOMAS, P.C., JYOTHI V.MALLIA, AND P.MUTHIAH. 2006. Induction of triploidy in Indian Edible Oyster *Crassostrea madrasensis* (Preston) using 6-dimethyl aminopurine. *Asian Fisheries Science*, 18 : 3 & 4.

VIJAY ANAND P.E. AND N.G.K. PILLAI. 2005. Community organization of coral reef fishes in the rubble sub-habitat of Kavaratti Atoll, Lakshadweep, India. *J. mar. biol. Ass. India*, 47(1): 77-82.

VIJAY ANAND P.E. AND N.G.K. PILLAI, 2005. Occurrence of juvenile fishes on the sea grass beds of Kavaratti Atoll, Lakshadweep, India. *Indian J. Fish.*, 52 (2) : 125-140.

VIJAYA KHADER, R. SATHIADHAS AND H. MOHAMMAD KASIM. 2005. Role of Women in Fisheries in Coastal Ecosystem of Andhrapradesh, Karnataka and Kerala. *Tamilnadu J. res.*, 33(1) : 53-59.

VIJAYAN K.K., I.S. BRIGHT SINGH, N.S. JAYAPRAKASH, S.V. ALAVANDI, S. SOMNATH PAI, R. PREETHA, J.S. RAJAN AND T.C. SANTIAGO. 2006. A brackishwater isolate of *Pseudomonas* PS-102, a potential antagonistic bacterium against pathogenic vibrios in penaeid and non-penaeid rearing systems. *Aquaculture*, 221: 97-106.

VIJAYAN K.K., V. STALIN RAJ., S.V. ALAVANDI, V. THILLAI SEKHAR, T.C. SANTIAGO. 2005. Incidence of white muscle disease (WMD), a viral like disease associated with mortalities in hatchery-reared postlarvae (PL) of the giant freshwater prawn *Macrobrachium rosenbergii* (de Man) from the south east coast of India. *Aquaculture Research*, 36 : 311-316.

VIVEKANADAN, E., M. SRINATH AND SOMY KURIAKOSE. 2005. Fishing down the marine food web along the Indian coast. *Fisheries Research*, 72: 241-252.

Technical Articles (peer reviewed)

ASHA, P.S. 2005. Reproductive aspects, larval and juvenile rearing of the sea cucumber *Holothuria* (Theelothuria) *spinifera* Theel (PhD Abstract). *SPC Beche-de-mer Information Bulletin* No. 22: 55-56.

BINDU SULOCHANAN. 2005. Instruments for saltation and sedimentation analysis. In: George J. Parayannilam (ed.) Mangrove ecosystems- A manual for the assessment of biodiversity. *CMFRI Special Publication* No. 83: 190-198.

DINESHBABU, A.P. 2005. Report on the fishery of 'Indian Ocean Lobsterette', *Nephropsis stewartii* Wood-mason 1872 along Mangalore coast. *Mar. Fish. Infor. Serv. T & E Ser*., No. 184: 18.

DHARMARAJ, S, K. K. SHANMUGASUNDARAM AND C.P. SUJA. 2005. Observations on the exploitation of clams in Tuticorin. *Mar. Fish. Infor. Serv. T & E Ser*., 184: 10-12.

DINESHBABU, A.P., B.SRIDHARA AND Y. MUNIYAPPA. 2005. Report on the first record of hairy crabs, *Portunus* (*Monomia*) *gracilimanus* (Stimpson, 1858) along west coast of India. *Mar. Fish. Infor. Serv. T & E Ser*., 184: 16.

DINESHBABU, A.P., LINGAPPA AND Y. MUNIYAPPA. 2005. A report on the landing of 'largetooth sawfish', *Pristis microdon* Latham, 1794 at Mangalore Fisheries Harbour. *Mar. Fish. Infor. Serv. T & E Ser*., 184: 20.

GEORGE, J.P. 2005. Mangrove Ecosystems: A manual for the assessment of biodiversity. *CMFRI Special Publication* No.83 : 222 pp.

GEORGE, J.P., M SRINATH, C. RAMACHANDRAN AND S. DAM ROY. 2005. Craft and Gear in mangroves responsible fishing. In: George J. Parayannilam (ed.) Mangrove ecosystems- A manual for the assessment of biodiversity. *CMFRI Special Publication* No. 83: 178-180.

JAYASANKAR, P. 2005. Towards reliance on molecular taxonomy for marine mammal conservation *CMFRI Newsletter* No. 107 (July-September), pp. 1,4.

JAYASURYA, P.K., P. KALADHARAN, M.S. RAJAGOPALAN, S. DAM ROY AND A.K. SADHU. 2005. Mangrove vegetation. In: George J. Parayannilam (ed.) Mangrove Ecosystem : A manual on methods for the assessment of biodiversity. *CMFRI Special Publication* No. 83: 1-14.

KALADHARAN, P., A. NANDAKUMAR, M. RAJAGOPALAN AND J.P. GEORGE. 2005. Mangroves in India: Biodiversity, conservation and management. *Mar.Fish.Infor.Serv. T&E Ser.*, 183: 8-14.

KALADHARAN, P. AND P.K. JAYASURYA. 2005. Development of herbarium for mangroves. In: In: George J.Parayannilam (ed.) Mangrove Ecosystem : A manual on methods for the assessment of biodiversity. *CMFRI Special Publication* No. 83: 15-16.

KALADHARAN, P., A. NANDAKUMAR, K.K. VALSALA AND ANSY MATHEW. 2005. Physiochemical parameters of water. In: In: George J. Parayannilam (ed.) Mangrove ecosystems- A manual for the assessment of biodiversity. *CMFRI Special Publication* No. 83: 190-198.

KASINATHAN, C. AND SANDHYA SUKUMARAN. 2005. A note on the coral reef degradation in some islands of Gulf of Mannar. *Mar. Fish. Infor. Serv*. *T&E Ser*., 184 : 15-16.

MOHAMED, K.S., V. KRIPA, T.S. VELAYUDHAN, P. RADHAKRISHNAN, P.S. ALLOYCIOUS, M. JOSEPH, J. SHARMA, L. RAVI, M. VINOD AND K.K. APPUKUTTAN. 2005. Accelerated growth of the Indian pearl oyster *Pinctada fucata* (Gould) in Kollam Bay, Southwest Coast of India. *Mar. Fish. Infor. Serv. T & E Ser.*, 186: 1-4.

MOHAMED, K.S, ZACHARIA, P.U., MUTHIAH, C., ABDURAHIMAN, K.P. AND NAYAK, T.H. 2006. A trophic model of the ArabianSea ecosystem off Karnataka and simulation of fishery yields for its multigear marine fisheries. Online at http.//www.ecopath.org/publications 1-83 (as PDF).

MUTHIAH, C., H.M. KASIM, N.G.K. PILLAI AND UMA S. BHAT, 2005. Exploited seerfish fisheries of India during 1998-02. *Mar. Fish. Infor. Serv., T&E Ser.*, 184: 1-10.

NAOMI, T.S., ANSY MATHEW, J.P. GEORGE, SUNIRMAL GIRI AND M. KALIAMOORTHY. 2005. Zooplankton fauna. In: George J. Parayannilam (ed.) Mangrove ecosystems- A manual for the assessment of biodiversity. *CMFRI Special Publication* No. 83: 36-82.

PREMA, D., N.K. SANIL AND P.S. SIVAPRASAD. 2006. Bibliography on "Diseases, Parasites and Toxicology of *Perna viridis*, *Crassostrea madrasensis* and *Villorita cyprinoids* (Mollusca: Pelecypoda) of India" . *CMFRI Special Publication* No. 88 : 67 pp.

RADHAKRISHNAN, E.V. 2005. Co-management: An alternative approach to lobster fisheries management. *CMFRI Newsletter* No.108: 1-3.

RADHAKRISHNAN, E.V. 2005. Broodstock development, breeding, hatchery production and restocking (ranching) of mud crabs. In: Fisheries Research - NATP Contribution Published by Agro-Ecosystem Director (Coastal), NATP, CTCRI, Thiruvananthapuram : 21-23.

RANI MARY GEORGE. 2005. Threats to coral reef biodiversity and the need for their conservation in India. *CMFRI Special Publication* No. 84: 65-68.

RAO, G.S. 2005. Marine Fisheries of Andhra Pradesh-an overview, In: Sustainable Fisheries Development: focus on Andhra Pradesh (Bhupendranath, M.R., Mathew, P.T., Gupta, S.S., Pravin, P and Jeeva, J.C. Eds.) p17-22, Society of Fisheries Technologists (India), Cochin.

REKHA DEVI CHAKRABORTY AND B.P. THUMBER. 2005. Fishery of *Parapenaeus longipes* along the Veraval coast. *Mar. Fish. Infor. Serv. T & E. Ser.*, 183 : 15.

SASIKUMAR, G., P.K. KRISHNAKUMAR AND G.S.BHAT. 2006. Monitoring trace metal contaminants in green mussel, *Perna viridis* from coastal waters of Karnataka, southwest coast of India. *Arch. Environ. Contam. Toxicol*. (Published online: http://dx.dol.org/10.1007/s00244-005-0055-2).

SATHIADHAS, R. 2005. Technology Diffusion-Training programmes under IVLP, *CMFRI Special Publication* No. 81 : 68 pp.

SATHIADHAS, R. 2005. Reaching the Unreached: Highlights of Institution Village Linkage Programe of CMFRI. *CMFRI Special Publication* No. 82 : 40 pp.

SATHIADHAS, R. 2005. *Apprapya thak Pahumchana. CMFRI Special Publication* No. 87 : 54 pp.

SATHIADHAS. R., FEMEENA HASSAN AND A.D. DIWAN. 2005. Adoption of fishery enterprises and empowerment options for fisherwomen of Kerala. In "Women empowerment in fisheries" Eds. A.S. Ninawe and AD. Diwan., Narendra publishing house, Delhi: 55-74.

SATHIADHAS, R., J.P. GEORGE, P.K. JAYASURYA AND ANSY MATHEW. 2005. Economic importance of mangroves, afforestation and reclamation. In: George J. Parayannilam (ed.) Mangrove ecosystems- A manual for the assessment of biodiversity. *CMFRI Special Publication* No. 83:.215-217.

SRINATH, M. SOMY KURIAKOSE AND MINI, K.G. 2005. Methodology for estimation of marine fish landings in India. CMFRI *Special Publication* No. 86 : 57pp.

SRINATH, M., SOMY KURIAKOSE, P.L. AMMINI, C.J. PRASAD, K. RAMANI AND M.R. BEENA. 2006 .Marine Fish Landings in India 1985-2004. Estimates and Trends. *CMFRI Special Publication* No. 89 : 161pp.

SUJA C.P. AND S.DHARMARAJ. 2005. In-vitro mantle tissue culture of abalone *Haliotis varia* Linnaeus, *Tissue and Cell*, 37(1):1-10.

SUJITHA THOMAS.2005. Bivalve resources in saline creeks of Saurashtra,Gujarat. *Mar. Fish. Infor. Serv. T&E Ser.*, 185: 21-22.

VIJAYAKUMARAN, K. 2005. Plankton-methods for study. In: In: George J. Parayannilam (ed.) Mangrove ecosystems- A manual for the assessment of biodiversity. *CMFRI Special Publication* No. 83: 17-19.

VIJAYAKUMARAN, K. 2005. Macro benthos-Methods for study. In: In: George J. Parayannilam (ed.) Mangrove ecosystems- A manual for the assessment of biodiversity. *CMFRI Special Publication* No. 83: 117-124.

VIJAYAKUMARAN, K. 2005. A note on the adoption of new fishing techniques by traditional fishers along Andhra Pradesh - Orissa Coast. *Mar.Fish.Infor.Serv, T&E Ser.*, 184 : 12-14.

VIVEKANANDAN, E., S.VENKATESAN AND G. MOHANRAJ, 2005. Artificial reef and its impact on artisanal fisheries. *Mar. Fish. Infor. Serv. T & E Ser*., 183 : 1-7.

VIVEKANANDAN, E. 2005. Stock Assessment of Tropical Marine Fishes. ICAR, New Delhi, 115 pp.

Symposia/Seminars/Workshops

ANOOP, A. K., R.N. DURGEKAR, P.U. ZACHARIA AND P.K. KRISHNAKUMAR. 2005. Effect of experimental bottom trawling on the benthic macrofauna off Mangalore coast, Karnataka, India. Abstract No. FE-5, Abstracts, p. 165. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

ASHA AUGUSTINE, IMELDA JOSEPH AND R.PAULRAJ. 2005. Changes in biomass and cell components of *Aspergillus niger* $s_1$4 and *Aspergillus oryzae* NCIM 1212 in solid-state fermentation. Abstract No. PHT 25, Abstracts, p. 130. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

ASHA, P.S. AND P. MUTHIAH. 2005. Seed production and growth of the commercial sea cucumber *Holothuria spinifera*. Theel. Abstract No. APS 39, Abstracts, p. 40. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

ASWATHY, N., R. SATHIADHAS, A. BASTIN FERNANDO AND M. SELVARAJ. 2005. Market structure, integration and efficiency of marine fish marketing in Tuticorin Region. Abstract No. SEP-2, Abstracts, p. 147. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

AYYAPPAN, S., N.G.K. PILLAI AND V.S. BASHEER.2005. Fisheries Heritage in India, *In* Nene,Y.L.(Ed.) Agricultural Heritage of Asia: Proceedings of the International Conference, 6-8 December 2004, Asian-Agri-History Foundation, Secunderabad, India. pp: 34-39.

AYYAPPAN, S., A. GOPALAKRISHNAN AND P. JAYASANAKAR. 2006. Fish Diversity of India and its Management on Integrated Rural Development: Science and Technology, 93rd Indian Science Congress, Jan 2-7, 2006, Hyderabad.

CHAKRABORTY, K. AND R. PAULRAJ. 2005. Effect of metallic ions and protein denaturing agents on the activity of phytase from *Bacillus licheniformis* MTCC 6824. Abstract No. EH-5, Abstracts, p. 114. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

DEBADAS BHATNAGAR, IMELDA JOSEPH AND R. PAULRAJ. 2005. Amylase and acid protease production by solid-state fermentation using *Aspergillus niger* from mangrove swamp. Abstract No. PHT-26, Abstracts, p. 131. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

DINESHBABU, A.P., B. SRIDHARA AND Y. MUNIYAPPA, 2005. Management of conventional marine shrimp resources for sustainable production along Mangalore coast. Abstract No. SFW-1, Abstracts, p. 133. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

FEMEENA HASSAN AND R. SATHIADHAS., 2005. Fisherwomen of Coastal Kerala – A socio economic perspective. Abstract No. SEP-6, Abstracts, p. 149. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

GIJO ITTOOP, K.C. GEORGE, N.K. SANIL, RANI MARY GEORGE, K.S. SOBHANA AND P.C.NISHA. 2005. Nuvan Induced Histopathology In the Indian Edible Oyster, *Crassostrea madrasensis* (Preston). Paper presented in UGC sponsored Seminar on Recent trends in Mariculture (19-20 July, 2005) at St. Peter's College, Kolenchery.

GIJO ITTOOP, K.C. GEORGE, N.K. SANIL, RANI MARY GEORGE, K.S. SOBHANA AND P.C. NISHA. 2005. Changes in the serum protein profile of the Indian edible oyster,*Crassostrea madrasensis* (Preston) on exposure to an organohosphorous pesticide, Nuvan, a heavy metal, copper and a bacterial pathogen, *Vibrio alginolyticus*. Paper presented in UGC sponsored seminar on Recent trends in Mariculture (19-20 July, 2005) at St. Peter's College, Kolenchery.

GOGULARAMANAN, G., K.S. SOBHANA, K.C. GEORGE AND R. PAUL RAJ. 2005. Humoral antibody response and protective immunity in the grouper, *Epinephelus malabaricus* immunised with whole cell killed vaccine preparation from a virulent strain of V*ibrio anguillarum.* Abstract No. EFH-20, The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

GOPAKUMAR, G. AND T.T. AJITHKUMAR. 2005. Troll line fishery for yellowfin tuna at Colachel, Kanyakumar Dist. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: *:* 177-180.

GOPAKUMAR, G. AND T.T. AJITHKUMAR, 2005. Fishery and population characteristics of the bullet tuna, *Auxis rochei* along South Kerala coast. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 64-72.

HONNANANDA, B.R AND P. KALADHARAN. 2005. Spectral signature of phytoplankton pigments and their significance to remote sensing. Abstract No. ARM-33, Abstracts, p. 14. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

HONNANANDA, B.R AND P. KALADHARAN. 2005. Characterization of algal blooms using spectral signatures: A study on *Noctiluca* bloom at Northern Arabian Sea. Abstract No. ARM-33, Abstracts, p. 14. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

HUXLEY, V. A. J. AND A. P. LIPTON. 2006. Marine natural products as anti-quorum sensing drugs with special reference to *Vibrio harveyi* auto-inducer (AHL) system. Book of Abstracts, p.19. National Seminar on Biomedicine in Aquaculture, 17-18 March 2005, Centre for Marine Science and Technology, Tamilnadu.

IMELDA JOSEPH, R.PAULRAJ AND D. BHATNAGAR. 2005. Solid state fermentation technology for nutritional improvement of aquafeed ingredients. Abstract No. APS-19, Abstracts, p. 32. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

JAYAN, K.N. R. SATHIADHAS, L. KRISHNAN, C. RAMACHANDRAN AND V.P. VIPINKUMAR. 2005. Technology assessment and refinement of farming practices in Vypeen island, Kerala: implication for designing effective and socially optimal development strategies. Abstract No. EEF-3, Abstracts, p. 160. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

JAYASANKAR, P., ANOOP A KRISHNAN AND M. RAJAGOPALAN. 2005. Cetacean sightings in the Southern Ocean. Abstract No. ARM-57, Abstracts, p. 22. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

JAYASANKAR, P. 2006. Alankar matchili palan (in Hindi). National Seminar in Hindi on 'Livelihood issues in Fisheries and Aquaculture' at CMFRI, Cochin : 73-77.

JYOTHI V.MALLIA, P.C.THOMAS AND P.MUTHIAH. 2005. Growth performance Meiotic I & Meiotic II triploid of edible Oyster *Crassostrea madrasensis* induced by blocking PB I & PB II. Abstract No. BGB-6, Abstracts, p. 74. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

KALADHARAN, P., A. NANDAKUMAR AND K.K. VALSALA. 2005. Trace metals in muscle tissue of marine fish from Port Blair and Kochi. Abstract No. EH-41, Abstracts, p. 114. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

JAGADIS, I., BOBBY IGNATIUS, D. KANDASAMI AND Md. AJMAL KHAN.. 2005. Brood stock development and captive breeding of Honey comb grouper *Epinephelus merra* at Mandapam, south east coast of India. Abstract No. BGB-36, Abstracts, p. 87. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

KASIM, H.M. AND E.M. ABDUSSAMAD. 2005. Stock assessment of coastal tunas along the East coast of India. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 42-53.

KASIM, H.M. AND E.M. ABDUSSAMAD. 2005. Stock assessment of seerfishes along the East coast of India. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 86-96.

KIZHAKUDAN, J.K. AND , S.J. KIZHAKUDAN. 2005. Role of Fishermen in Conservation and Management of Marine Fishery Resources in Gujarat, India – Some Case Studies. *In*: Book of Abstracts: Third International MARE Conference – People and the Sea III: New Directions in Coastal and Maritime Studies, Amsterdam, The Netherlands, July 2005.

KIZHAKUDAN, S.J., J.K. KIZHAKUDAN AND M.S. ZALA. 2005. Some observations on the fishery of whitefish *Lactarius lactarius* off Gujarat coast . Abstract No. ARM-15, Abstracts, p. 7. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

KRISHNAKUMAR, P.K., P. KALADHARAN, K. VIJAYAKUMARAN, SHOBHA KIZHAKUDAN, D. PREMA, JOE KIZHAKUDAN, A.P. DINESHBABU, A. NANDAKUMAR, G.S. BHAT AND T. HARISH NAYAK. 2005. Impact of altered river flow on the biogeochemistry and productivity of the seas along the east and west coast of India. Abstract No. ARM-29, Abstracts, p. 12. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

KRISHNAKUMAR, P.K., PRATHIBHA ROHIT, T. HARISH NAYAK AND M. RAJAGOPALAN. 2006. Assessing the impacts of climate change on Indian marine fisheries and identifying regime shifts. *In*: B.M. Kurup (Ed), Proceedings of the International Workshop on *Improved sustainability of fish production systems and appropriate technologies for utilization*. School of Industrial Fisheries, Cochin University of Science and Technology, Cochin, p. 63

KRISHNAN, L., R. SATHIADHAS, JAYAN, K.N. AND SINDHU SADANANDAN. 2005. Impact of techno-interventions on finfish culture among selected farmers of Elamkunnapuzha village under the Institution Village Linkage Programme. Abstract No. EEF-6, Abstracts, p. 161. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

LAKSHMI PILLAI, S., K.K. SUKUMARAN, JOE K. KIZHAKUDAN AND P. THIRUMILU. 2005. The penaeid shrimp resources and their fishery along the Chennai coast, Tamilnadu. Abstract No. ARM-17, Abstracts, p. 8. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

LIPTON, A.P. 2006. Marine Natural Products (MNPs) and their applications in managing disease problems in aquaculture. Book of Abstracts. National Seminar on Biomedicine in Aquaculture, March 17-18, Centre for Marine Science and Technology, Tamilnadu, p. 3-4.

LIPTON, A.P., M.K. ANIL AND J. ANDREWS. 2006. Marine biodiversity- its conservation and utilization. Biodiversity Awareness Workshop organized by the Biodiversity Authority of India. Abstract of papers. p.18-20.

LIPTON, A.P., J. J. JOSE, S. K. SUBHASH AND A. UDAYAKUMAR. 2006. Increased production of shrimp, *Penaeus monodon* in farm condition by incorporating Marine Natural Products and Probiotics – A case study. Book of Abstracts, p.35 National Seminar on Biomedicine in Aquaculture, March 17-18, Centre for Marine Science and Technology, Tamilnadu, p.35.

MOHAMED, K.S., P.U. ZACHARIA, C. MUTHIAH AND K. P. ABDURAHIMAN. 2005. Simulation and prediction of fishery yields in the multigear marine fisheries of Karnataka. Abstract No. FE-2, Abstracts, p. 164. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

MOHAN JOSEPH MODAYIL, N.G.K. PILLAI AND U. GANGA 2005. An Overview of coastal tuna resources and their fisheries in Indian waters. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 1-10.

MOHANRAJ, G., S. GOMATHY AND HAMEED BATCHA. 2005. Status of sciaenid fish resources of India. Abstract No. ARM-13, Abstracts, p. 7. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

MUTHIAH, C., AND N.G.K. PILLAI. 2005. Status of seerfish fishery in the Indian seas. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 73-85.

MUTHIAH, C., N.G.K. PILLAI, U. GANGA AND M. SRINATH. 2005. Stock assessment of seerfishes along the west coast of India. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 97-111.

NANDAKUMAR, G., E.V.RADHAKRISHNAN, K. CHELLAPPAN AND P.K.BABY. 2005. Observations on the shrimp fishery by mini-trawling along Alleppey coast, Kerala. Abstract No. FE-1 Abstracts, p. 164. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

NARAYANAKUMAR, R., R. SATHIADHAS. 2005. Techno economic efficiency of resource use in trawl fishing in Andhra Pradesh – a case study in Kakinada. Abstract No. SEP-13, Abstracts, p. 152. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

PILLAI, N.G.K. AND U. GANGA. 2005. An appraisal of marine captures fisheries management in India. *Proc. Ocean life, Food & Medicine Expo*, AFI, Chennai : 123-131.

PILLAI, N.G.K., U. GANGA, G. GOPAKUMAR, C. MUTHIAH AND SOMY KURIAKOSE. 2005. Stock assessment of coastal tunas along the West coast of India. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 54-57.

PILLAI, N.G.K., U. GANGA AND H.K. DHOKIA. 2005. Status of long tail tuna *Thunnus tonggol* fishery along the North-West coast of India. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 58-63.

RADHAKRISHNAN, E.V. 2005. Breeding and hatchery technology development of spiny lobsters and crabs – A Review. *Proc. Ocean life, Food & Medicine Expo*, AFI, Chennai : 265-272.

RADHAKRISHNAN, E.V., MARY K. MANISSERI, JOSILEEN JOSE, SUBODHAKUMAR PATRA AND LIYA AMBIPILLAI. 2005. Broodstock development and larval culture protocols for large scale seed production of the mud crab *Scylla serrata* (Keenan *et al*., 1998). Abstract No. BGB-12, Abstracts, p. 77. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

RADHAKRISHNAN, E.V. AND R. THANGARAJA. 2005. Sustainable exploitatioan and conservation of lobster resources in India-A participatory approach. Book of Abstracts, p. 10 National Seminar on Biodiversity Conservation Management, 22 & 23 July 2005, Biotech Consortia and ICBM, Department of Biotechnology, Malankara Catholic College, Mariagiri.

RADHAKRISHNAN, E.V., G. NANDAKUMAR AND MARY K. MANISSERI. 2006. Bharat mem crustacea matsyaki ke tikau utpadan and prabandhan. Proc. Livelihood Issues in Fisheries and Aquaculture. *CMFRI Special Publication* (Hindi) No. 90: 29-33.

RAJAGOPALAN. M., P. KANNAN AND S. VENKATESAN. 2005. Bioaccumulation of heavy metals in sea turtles from the west coast of India. *Proc. Ocean life, Food & Medicine Expo*, AFI, Chennai : 577-586.

RAJKUMAR, U., G.MAHESWARUDU, A.K.V. NASER, K. NARAYANA RAO, H. JHOSE KINGSLY, J.B. VARMA AND M. PRASADA RAO. 2005. Trawl fisheries off Visakhapatnam, In: *Sustainable fisheries development*: *Focus on Andhra Pradesh* (Boopendranath, M.R., Mathew, P.T., Gupta, S.S., Pravin, P. and Jeeva J.C., Eds). Society of Fisheries Technologists India, Cochin: 35-49.

RAJU, A., I. RAJENDRAN, I. JAGADIS, D. KANDASAMI, S. PALANICHAMY, N. RAMAMOORTHY AND A. PALANICHAMY. 2005. Spontaneous spawning and larval rearing of the camouflaged grouper, *Epinephelus polyphekadion* (Bleeker) in captivity at Mandapam. Abstract No. BGB-39, Abstracts, p. 88. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

RAMACHANDRAN, C. AND R. SATHIADHAS. 2005. Teaching to fish or learning not to fish? reinventing a responsible marine fisheries extension system in India. Abstract No. EEF-2, Abstracts, p. 159. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

RAMACHANDRAN, C. 2006. Livelihood security of fisher folk through Responsible Fisheries. Proc. Livelihood Issues in Fisheries and Aquaculture. *CMFRI Special Publication* (Hindi) No. 90: 25-27.

RANI MARY GEORGE. 2005. Glimpses on the Marine Biodiversity of India. Book of Abstracts, p. 10. National Seminar on Biodiversity Conservation Management, 22 & 23 July 2005, Biotech Consortia and ICBM, Department of Biotechnology, Malankara Catholic College, Mariagiri.

RANI MARY GEORGE AND SANDHYA SUKUMARAN. 2005. Status report on hard coral biodiversity, their threats and conservation. Book of Abstracts p. 12-13. National Seminar on Biodiversity Conservation Management, 22 & 23 July 2005, Biotech Consortia and ICBM, Department of Biotechnology, Malankara Catholic College, Mariagiri.

REKHA J. NAIR. 2005. An overview of the finfish diversity of Indian waters with a note on conservation strategies. Book of Abstracts, p. 11-12. National Seminar on Biodiversity Conservation Management, 22 & 23 July 2005, Biotech Consortia and ICBM, Department of Biotechnology, Malankara Catholic College, Mariagiri.

REKHA J. NAIR. 2005. Fishery of Malabar sole *Cynoglossus macrostomus* Norman off Cochin, Kerala. Abstract No. ARM-14, Abstracts, p. 7. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

ROHIT, P., P.U. ZACHARIA, A.P. DINESHBABU, G. SASIKUMAR AND C. MUTHIAH. 2005. Present Status of Marine Fisheries of Mangalore-Malpe Region of Karnataka State, India. Abstract No. ARM-39, Abstracts, p. 16. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

SANDHYA SUKUMARAN AND RANI MARY GEORGE. 2005. Coral reef biodiversity of Mandapam and Kilakarai group of islands in Gulf of Mannar Biosphere Reserve. Abstract No. ARM-11, Abstracts, p. 6. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

SASIKUMAR, G., P.K. KRISHNAKUMAR, S. THOMAS, G. SAMPATHKUMAR, D. NAGARAJA AND G.S. BHAT. 2005. Influence of environmental factors on the growth rate of *Crassostrea madrasensis* (Preston) in suspended culture. Abstract No. APS-22, Abstracts, p. 33. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

SATHIADHAS, R. 2005. Policy issues for marine fisheries management in India. Abstract No. SEP-8, Abstracts, p. 150. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

SATHIADHAS, R AND SANGEETHA.K.PRATHAP. 2005. Socio Economic impact of tsunami on fisheries and coastal communities in Kerala. Abstract No. SEP-7, Abstracts, p. 150. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

SAID KOYA, K.P., N.G.K. PILLAI AND M.C. MUTHU KOYA. 2005. Present status of tuna fisheries of Lakshadweep. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 26-32.

SAID KOYA, K.P. AND A.K.V. NASSER, 2005. Status of exploitation of tuna live baits of Lakshadweep. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 122-131.

SELVIN, J., S. JEYASHREE, G. S. KIRAN AND A. P. LIPTON. 2006. Production of antimicrobial agents from *Saccharomonospora* sp. associated with sea urchin *Strongylocentrotus* sp. Book of Abstracts, p.12. National Seminar on Biomedicine in Aquaculture, March 17-18, Centre for Marine Science and Technology, Tamilnadu, p. 12.

SELVIN, J. AND A. P. LIPTON. 2006. Marine Secondary Metabolites: A potential source for developing shrimp grade therapeutic formulations. Book of Abstracts, p.13. National Seminar on Biomedicine in Aquaculture, March 17-18, Centre for Marine Science and Technology, Tamilnadu, p.13.

SIVADAS, M., K.P. SAID KOYA AND N.G.K. PILLAI, 2005. Stock assessment of oceanic skipjack, *Katsuwonus pelamis* from Minicoy, Lakshadweep. *In:* V.S. Somvanshi, S. Varghese and A.K. Bhargava (Eds.). *Proc. Tuna Meet - 2003*: 168-176.

SIVAKAMI, S., 2006. Livelihood issues of marine fisherfolk in India. Proc. Livelihood Issues in Fisheries and Aquaculture. *CMFRI Special Publication* (Hindi) No. 90:11-16.

SOBHANA, K.S., G. GOGULARAMANAN, K. C. GEORGE AND R. PAUL RAJ. 2005. Virulence and pathology of *Vibrio anguillarum* isolates in the grouper, *Epinephelus malabaricus*. Abstract No. EH-5, Abstracts, p. 100. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

SUJOY BISWAS, M.K. ANIL, A.P. LIPTON AND RANI MARY GEORGE. 2005. Life cycle and molt studies of *Eurobowmaniella simulans* (Crustacea: Mysidacea) from the nearshore waters off Vizhinjam, Southern Kerala. Abstract No. ARM-56, Abstracts, p. 22. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

THOMAS, P.C. 2006. Application of quantitative genetics for sustainable aquaculture. In: Livelihood Issues in Fisheries and Aquaculture. *CMFRI Special Publication* (Hindi) No.90 : 57- 61.

THOMAS, S, SASIKUMAR, G., ROHIT, P AND G. SAMPATHKUMAR. 2005. Influence of seed source on the growth of green mussel, *Perna viridis* cultured by rack method in Mulki estuary, Karnataka State, India. Abstract No. ARM-31, Abstracts, p. 13. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

VELAYUDHAN, T.S., MANOJ NAIR, N.R MENON. 2005. Taxonomic Status of the Indian pearl oyster *Pinctada fucata* (Gould). In: Book of Abstracts No. 428 p. 677 World Aquaculture 2005 (May 9-13, 2005) in session "Culture of Pearl Oysters" conducted by World Aquaculture Society & held at Bali – Indonesia, Jakarta. B. Abstract, page 677.

VELAYUDHAN, T.S., MANOJ NAIR, N.R MENON. 2005. Studies on morphology and anatomy of the Indian pearl oyster *Pinctada fucata* (Gould). In: Book of Abstracts No. 428 p. 678 World Aquaculture (May 9-13, 2005) in BOARD "MOLLUSC CULTURE POSTERS" conducted by World Aquaculture Society & held at Bali – Indonesia, Jakarta B.

VIJAYAKUMARAN, K. 2005. Conservation of Turtles and Turtle Excluder Device. In: Bhoopendranath, M.R., P.T.Mathew, S.S. Gupta, P. Pravin and J.C.Jeeva (Eds), *Sustainable Fisheries Development. Focus on Andhra Pradesh*, SOFTI, Cochin: 122-128

VIJAYAN, K.K. 2006. Disease causing pathogens, disease problems and application of health management in the ornamental fish keeping. Book of Abstracts, p. 43. International Seminar on Ornamental Fish Breeding, Farming and Trade, Cochin.

VIPINKUMAR, V.P. 2005. Impact of Mussel Farming by the Self Help Groups of Fisherfolk : A Case Study. Proc. National Seminar on Extension Methodological Issues in Impact Assessment of Agricultural and Rural Development Programmes, p. 93-94. Indian Society of Extension Education, New Delhi.

VIPINKUMAR, V.P. 2005. Livelihood Analysis of Coastal Fisherfolk for Technological Empowerment – An Appraisal in Kerala. p. 98 *In Compendium of abstracts of National Seminar on Green to ever green: challenges to extension education*, Indian Society of Extension Education, IARI, New Delhi.

VIPINKUMAR, V.P. 2005. Livelihood Analysis of Coastal Fisherfolk : A Case Study in Kerala. Proc. Livelihood Issues in Fisheries and Aquaculture. *CMFRI Special Publication* (Hindi) No. 90 : 21-24.

VIPINKUMAR, V.P. 2005. Extension of Mussel Farming through Community Participation in Karnataka – A Case Study. Abstract No. EEF-7, Abstracts, p. 162. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

ZACHARIA, P.U, ANOOP, A. KRISHNAN, R.N. DURGEKAR AND P.K. KRISHNAKUMAR. 2005. Immediate effect of bottom trawling on the physico-chemical parameters of sea water and sediment off Mangalore coast, India. Abstract No. FE-13, Abstracts, p. 168. The Seventh Indian Fisheries Forum, 8-12 November 2005, Bangalore, India.

ZACHARIA, P.U., P.K. KRISHNAKUMAR, C. MUTHIAH, ANOOP A. KRISHNAN AND R. N. DURGEKAR. 2005. Quantitative and qualitative assessment of discards associated with bottom trawling along Karnataka during 2001-2002. In: (B. M. Kurup, ed.,) *Proc. Symp. Sustain Fish 2005*, Cochin, India : 53.

Popular Articles

ASHA, P.S. 2005. Sea Cucumber. In: Souvenir on scientific Seminar in Hindi held at Heavy Water Plant, Tuticorin. p. 27-28.

AYYAPPAN, S. AND N.G.K PILLAI. 2005. Indian Fisheries in global context. *Indian Farming.* October 2005 : 16-24.

GEORGE, J.P. 2005. Mangrove ecosystem: Conservation and Management, Hindi publication of ICAR, *Krishi chayanika*.

KALADHARAN, P. 2005. *Thadey our samudrii paryavaran ka badhaltha chehara* in Hindi (Changing face of coastal and marine Environment). *Matsyagandha*, 5: 51-56.

KANNAN, P., S. VENKATESAN, M. RAJAGOPALAN AND E. VIVEKANANDAN. 2005. Stranding of Green turtle along the Saurashtra coast, Gujarat, India. *Marine Turtle Newsletter* No. 110: 4-5.

KANNAN, P. AND M. RAJAGOPALAN. 2005. Observation of Green turtle in the Lakshadweep Islands, west coast of India. *Marine Turtle Newsletter* No. 110: 7.

KANNAN, P. AND M. RAJAGOPALAN. 2005. Sightings of sea turtles in the Andaman Sea and Bay of Bengal, *Indian Ocean Turtle Newsletter* No. 2: 7-9.

MINI, K.G AND SOMY KURIAKOSE. 2005. Application of The code of Conduct for Responsible Fisheries for the Effective Management of Marine Fisheries In India. *CMFRI Special Publication No.85, Matsyagandha 2004 (5)* :.27-29.

RAMACHANDRAN, C. AND R. SATHIADHAS. 2005. Greening the Pink Gold – A perspective on the Economic Potential and Market/Trade prospects of organic Aqua products in India. *Sea Food Export Journal (XXXV)* : 15-27.

RAO, G.S. 2005. Onshore (Land based) Culture of pearl oysters for pearl production. *Fishing Chimes* 25 (I): 142-146.

REKHA J. NAIR. 2005. Fisheries and Biodiversity Conservation. *Matsyagandha 2004*: 57 – 59.

SIVAKAMI, S. 2006. Fish behaviour - how and why? In: *Tharangam*, pp.64 -67.

SINGH, V.V. 2005. Use of GPS in GIS applications. Ed. Chandrakant Course manual of the training programme on *Farm layout, design and instrumentation"* CIFE (Deemed University), Mumbai, 16-30 May 2005 : 315-319.

SOMASEKHARAN NAIR, K.V. AND P.K.ASOKAN. 2005. Strategies for sustainable marine fisheries development in Gujarat. *Matsyagandha 2004*: 45–50.

SOMY KURIAKOSE, MINI, K.G AND NEETHA SUSAN DAVID. 2005. Ecosystem Based Management for a Transition Towards Responsible fishing. *CMFRI Special Publication No.85, Matsyagandha 2004* (5): 37-40.

VIJAYAGOPAL, P. 2005. Aquaculture feed microscopy – a new step in feed quality control (*Jalkrishi khad sookshmadarshan – khad gun niyanthran may ek naya kadam*). *Matsyagandha 2004, CMFRI Special Publication* No. 85:5.

Approved Ongoing Projects

In-house Projects

SL. NO.	Project Code No.	Title of the Project
1	FRA/ASSESS/01	Assessment of exploited marine fishery resources
2	FRA/ASSESS/02	Stock assessment techniques in marine fish and shellfish resources and management
3	FEM/01	Monitoring the environmental characteristics of the inshore waters in relation to fisheries
4	FEM/02	Monitoring environmental contaminants from coastal waters with reference to bioaccumulation and biomagnification in fishes
5	FEM/04	Development of strategies for sea turtle and sea cucumber conservation
6	FEM/07	GIS based atlas on potential mariculture sites along Indian coasts
7	PNP/NUT/01	Development of cost- effective and eco-friendly feeds for cultivable marine crustaceans and finfish by biotechnological interventions
8	PNP/BIOT/01	Biotechnological interventions in disease diagnosis and management in mariculture
9	SEE/PMS/01	Price behaviour and marketing system of marine fisheries in India
10	SEE/ECO/01	Economics of marine fishing operations and social costs/benefits
11	MBD/01	Studies on the coral biodiversity of the Gulf of Mannar Biosphere Reserve
12	MBD/02	Species diversity of exploited marine fishery resources of Indian coasts
13	MBD/03	Studies on the specific and intra specific diversity of carangids of the Indian seas
14	MD/CUL/01	Seed production for shellfish mariculture
15	MD/CUL/02	Development of diversified and sustainable grow out mariculture systems
16	MD/CUL/03	Broodstock development and seed production of finfishes
17	MD/CUL/04	Mass culture of live feeds and nutritional enrichment for larviculture
18	NBFGR-CMFRI/DNA/01 (Collaborative mode)	Genetic divergence studies in prioritized marine finfish and shellfish
INTER-DIVISIONAL PROJECTS		
19	DEM/IDP/01	Appraisal of marine fisheries of Gujarat
20	CF/IDP/03	Appraisal of marine fisheries of Maharashtra
21	PEL/IDP/02	Appraisal of marine fisheries of Goa & Karnataka
22	PEL/IDP/01	Appraisal of marine fisheries of Kerala
23	DEM/IDP/02	Appraisal of marine fisheries of Tamil Nadu& Pondicherry
24	MF/CAP/01	Appraisal of marine fisheries of Andhra Pradesh
25	DEM/CAP/03	Appraisal of marine fisheries of Orissa
26	FRA/IDP/01	Appraisal of marine fisheries of West Bengal
27	PEL/IDP/03	Appraisal of marine fisheries of the Lakshadweep Islands
28	MF/CAP/02	Building trophic models and fisheries management simulations for the Indian Seas: Part 1 - Northwest coast (NWC) and Gulf of Mannar (GOM) ecosystems
29	CF/IDP/02	Studies on discards and low value bycatch of trawlers
30	SEETTD/IM/01	Impact of management and technological interventions on marine fisheries and coastal livelihood
31	CF/IDP/01	Impact of selective fishing of juvenile and brood fish, FADs and sea ranching on stock health

Sponsored Projects

SL. NO.	Project Code No.	Title of the Project
1.	ERP/MPD/04	Participatory management and conservation of lobster resources along the Indian coast
2.	ERP/APC/21	Development of pro-active disease control strategies for sustainable shrimp farming using marine algal metabolites
3.	ERP/APC/22	National risk assessment programme for fish and fish products for domestic and international markets
4.	ERP/DOD/09	Farming and pearl production in the Black lip pearl Oyster *Pinctada margaritifera* in Andaman and Nicobar Islands
5.	ERP/DOD/10	Studies on marine mammals of Indian Exclusive Economic Zone and the contiguous seas
6.	ERP/DOD/11	Predictive modeling of marine fisheries of the south west coast of India
7.	ERP/APC/25	Economic evaluation of trawl fishing in Andhra Pradesh and Kerala
8.	ERP/APC/24	Cattle feed production from selective seaweeds of Indian Coast
9.	ERP/APC/19	Technological upgradation of edible oyster farming through development of remote setting and upwelling techniques
10.	ERP/APC/29	Brood stock development, larval rearing and seed production of marine crab *Portunus pelagicus*
11.	ERP/APC/26	Assessing the impact of fishing on the biodiversity pattern of commercial marine fishery resources of South west coast of India
12.	ERP/APC/(Net)/38	Impact, adaptation and vulnerability of Indian Agriculture to climate change
13.	ERP/DOD/14	Tuna Resources of the Indian EEZ-An assessment of growth and migratory patterns
14.	ERP/DOD/13	Stock Assessment and Biology of deep-sea fishes in the continental slope of EEZ.
15.	ERP/MoA/01	Floating cage farm for marine finfish and shellfish
16.	ERP/DSR-ICAR/01	Seed production in agricultural crops and fisheries
17.	ERP/APC (Net)/54	Investigation on 'Loose Shell Syndrome' among farmed tiger shrimp Penaeus monodon
18.	ERP/APC/55	Development of gene constructs for production of WSSV resistant penaeid shrimp and its validation in shrimp cell culture system
19.	NATP/PSR	Breeding and culture of pearl oyster and production of pearls
20.	NATP	Institution-Village-Linkage-Programme (IVLP) for Technology Assessment and Refinement (TAR) in the Coastal Agro Ecosystem of Ernakulam in Kerala.
21.	NACA-ICAR	Application of PCR for improved shrimp health management in the Asian region

Consultancies & Sequence Submissions

A. Consultancies during the year 2005-2006

Sl.No	Name of Client	Project Title	Duration	Amount (Rs.)
1	NIO, Mumbai-53.	Environmental baseline studies & EIA for development operations in NEC25 offshore block.	April. 2005 July.2005.	1,10,000/-
2	M/s. Reliance, Mumbai	Turtle monitoring off Orissa Coast	May.2005 to Nov.2005	10,40,000/-
3	M/s.KIOCL, Kudremukh	Water quality monitoring and silt load modeling studies on Bhadra river in the mining area of KIOCL Phase-2	Jun.05-Dec.05	14,00,000/-
4	Karnataka State Biodiversity Board, Bangalore	Survey, Inventorisations database creation	Sep.05-Jun.06	20,00,000/-
5	Andhra Pradesh Dept.of Fisheries, Hyderabad	Training on data collection for AP state officials.	Sept-2005	1,96,839/-
6	M/s. KIOCL,Mangalore	Chemical parameters of the effluent and hydrobiological conditions in the effluent receiving water off Thannirbavi. (Phase-9)	Sep-2005-Aug.2006	4,18,760/-
7	M/s.GMREL,Mangalore	Monitoring studies on the hydrobiological conditions in the Arabian Sea off Thanirbavi , near the marine outfall of Thanir bavi Power Plant Facility M/sGMREL, Mangalore (Phase-4)	Oct.2005-May2006	3,30,600/-
8	Tamil Nadu Dept. Fisheries, Chennai.	Site Selection and Monitoring of Artificial Reef in Ten Selected Locations in Tamilnadu.	Oct.2005-Sept.2008.	24,26,923/-
9	M/s. Chennai Water Desalination ltd,Chennai-97.	RIA of high saline effluent from proposed desalination plant at Minjur.	Feb-2006-July-2006	36,76,237/-
		Total Amount		**1,15,99,359/-**

B. Gene/DNA Sequence Submissions

Sl..No.	Gene/DNA sequence	GenBank Accession number	Authors
1	*Delphinus tropicalis* clone D1.5 cytochrome b (cytb) gene, partial cds; mitochondrial	DQ320765	Jayasankar, P., Rajagopalan, M., Reynold, P. and Anoop, B.
2	*Delphinus tropicalis* clone D2.5 cytochrome b (cytb) gene, partial cds; mitochondrial	DQ320766	Jayasankar, P., Rajagopalan, M., Reynold, P. and Anoop, B.
3	*Grampus griseus* isolate CH15 cytochrome b (cytb) gene, partial cds; mitochondrial.	DQ270178 & DQ270179	Jayasankar, P., Rajagopalan, M., Reynold, P. and Anoop, B.
4	*Neophocaena phocaenoides* isolate MNG7 control region, partial sequence; mitochondrial	DQ364690 & DQ364692	Jayasankar, P., Rajagopalan, M., Anoop, B., Reynold, P., Krishnakumar, P.K. and Anoop, A.K.
5	*Neophocaena phocaenoides* isolate MNG8 cytochrome b (cytb) gene, partial cds; mitochondrial	DQ364691 & DQ364694	Jayasankar, P., Rajagopalan, M., Anoop, B., Reynold, P., Krishnakumar, P.K. and Anoop, A.K.
6	*Physeter catodon* isolate CHW1 cytochrome b (cytb) gene, partial cds; mitochondrial	DQ364689 & DQ364693	Jayasankar, P., Rajagopalan, M., Anoop, B., Reynold, P., Krishnakumar, P.K. and Anoop, A.K.
7	*Sousa chinensis* isolate MNG4 cytochrome b (cytb) gene, partial cds; mitochondrial	DQ364689 & DQ364693	Jayasankar, P., Rajagopalan, M., Anoop, B., Reynold, P., Krishnakumar, P.K. and Anoop, A.K.
8	*Stenella longirostris* isolate CH07 cytochrome b (cytb) gene, partial cds; mitochondrial	DQ232770 & DQ232772	Jayasankar, P., Rajagopalan, M., Reynold, P. and Anoop, B.
9	*Stenella longirostris* isolate VRC/DOL/05 cytochrome b (cytb) gene, partial cds; mitochondrial	DQ270182 & DQ270183	Jayasankar, P., Rajagopalan, M., Reynold, P. and Anoop, B.
10	*Tursiops aduncus* isolate VIZ1 cytochrome b (cytb) gene, partial cds; mitochondrial	DQ232769 & DQ232771	Jayasankar, P., Rajagopalan, M., Reynold, P. and Anoop, B.
11	*Tursiops aduncus* isolate CH04 cytochrome b (cytb) gene, partial cds; mitochondrial	DQ270184 & DQ270185	Jayasankar, P., Rajagopalan, M., Reynold, P. and Anoop, B.

Meetings

QRT

The QRT under the Chairmanship of Dr. E.G. Silas, Former Vice-Chancellor of Kerala Agricultural University submitted the report to Director General of ICAR in September, 2005. The recommendations were examined by ICAR General Body and some of the recommendation were accepted and action has been initiated to implement those recommendations.

SRC

The 12th Reconstituted Staff Research Council Meeting of the Institute was held at the Headquarters from 24-28 May 2005. The DDG (Fy), Dr. S. Ayyappan, and ADG (M.Fy), Dr. A.D. Diwan attended the meeting and reviewed the progress of research projects. 59 SRC members from CMFRI and 10 Scientists from CIFT attended the meeting and presented the progress under various inhouse and funded projects. 51 inhouse projects and 14 externally funded projects were reviewed. The SRC decided to continue 18 inhouse research projects and 33 research projects of resource assessment divisions were either closed or merged with other ongoing projects. 13 new inter-divisional projects were proposed and a Core Committee constituted by the Director examined these proposals and forwarded the projects to SRC for approval. SRC formerly approved the projects and in a meeting of Core Committee held during 22-24 June, 2005, the projects were finalised. The projects submitted by Principal Investigators were finally accepted and became effective from 1st July 2005.

Meeting of PME Cell

The first meeting of Priority setting, Monitoring and Evaluation (PME) Cell was conducted on 3rd October 2005 under the Chairmanship of Prof. (Dr.) Mohan Joseph Modayil, Director, CMFRI.

Following are the reconstituted members of PME Cell:

Dr.E.V.Radhakrishnan, Head, CFD	Scientist in-Charge
Dr. R. Sathiadhas, Head, SEETTD	Member
Dr.Sunil Mohamed, Head, MFD	Member
Dr.L.Krishnan, Principal Scientist, DFD	Member
Dr.P. Jayasankar, Senior Scientist, PNPD	Member
Dr.J. Jayasankar, Scientist, FRAD	Member

The Scientist-in-Charge explained the proceedings of the workshop held at NCAP, New Delhi. The Cell has to ensure that the in-house projects at different regional and research centres are operating as per the targets fixed and if any constraints found shall be brought to the attention of the Director. The cell convened the 12th Staff Research Council meeting in May 2005 and the Core Committee meeting in June 2005 to finalise the reoriented projects. The approved projects were sent to all the Scientists for implementation. The QRT report submitted by the Chairman, QRT was forwarded to DG, ICAR. The six monthly targets and achievements of each Scientist under the research projects were electronically submitted to DG after the review by the Director. The PME Cell edited and published

the Annual Report 2004-05. A consolidated report on monitoring and evaluation of the progress of the research projects was submitted to the Director.

IMC

The 61st IMC of CMFRI was held on 06.04.2005 at CMFRI, Kochi. The meeting was chaired by Prof. (Dr.) Mohan Joseph Modayil and other members who attended were Joint Director of Fisheries, Govt. of Kerala, Director of Research, Kerala Agricultural University, Shri C.K. Soman and Shri Mani C. Kappen, Non-Official members, SFAO, CPCRI, Dr. R. Paul Raj, Head, PNPD, Dr. R. Sathiadhas, Head, SEETTED, Dr. S.A. Ali, Principal Scientist, CIBA, Chennai and Dr. S.K. Chakraborty, Principal Scientist, CIFE, Mumbai. Shri K.L. Meena, SAO & Member Secretary presented the action taken report. Minutes of the 60th meeting of IMC held on 09.11.2004 was approved. As new items – (i) Demolition of Dilapidated Ice-Plant building at Kovalam F.L of Madras R.C. of CMFRI, (ii) Condemnation and replacement of two old lifts at CMFRI, Kochi, (iii) Maintenance/petty works undertaken under Non-Plan 2004-2005 at CMFRI, Kochi, (iv) Utilisation of funds under Plan & Non-Plan 2004-05 at CMFRI – Re-appropriation of funds from other charges to works under Non-Plan, (v) Provision of ATM facility in CMFRI Campus were approved.

The 62nd IMC of CMFRI was held on 25.11.2005 at CMFRI, Kochi. Minutes of the 61st meeting of IMC held on 06.04.2005 was approved. As new items – (i) Write-off the loss of Labomed Electrical Microscope, (ii) Appointment of part-time Registered Medical Practitioner as AMA at Mandapam RC of CMFRI, (iii) Dismantling of the old residential quarters at Mandapam Regional Centre of CMFRI, (iv) Replacement of existing Diesel Generator set and transformer at CMFRI, Kochi, (v) Re-appropriation of funds from the overall savings of Plan grant 2005-06 (under the Head 'Equipments') for payment towards the purchase of four Visualizers for Tuticorin, Visakhapatnam, Calicut and Mangalore Regional Research Centres, were approved.

The 63rd IMC of CMFRI was held on 22.03.2006 at CMFRI, Kochi. Minutes of the 62nd meeting of IMC held on 25.11.2005 was approved. As new items – (i) Proposal for undertaking the Consultancy Project on "Rapid Impact Assessment of high saline effluent from the proposed desalination plant at Minjur, on the coastal marine life and fishery" received from M/s. Chennai Water Desalination Ltd., Chennai, (ii) Booking of expenditure towards procurement of 4 Nos. of Audio Visualizers under Plan for 2005-06, (iii) Awarding contract for security services at CMFRI Hqrs. Kochi and its Regional/Research Centres, exceeding the limit of Rs.10.00 lakh per annum, (iv) Re-appropriation of funds from the sub head "HRD" & "Other items" to "Other Charges" under Plan 2005-06, (v) Maintenance/Petty Works undertaken under Non-Plan 2005-06 at CMFRI, were approved.

10th Institute Joint Staff Council

The new Joint Staff Council was constituted with the following officials vide this Office Order No. 6-12/2005-Estt. Dated 25.11.2005.

Official side

1.	Director, CMFRI	-	Chairman
2.	Shri K.L. Meena, SAO	-	Member
3.	Shri G.P. Sharma, SFAO	-	Member
4.	Dr. R. Paul Raj, SIC, PGPM	-	Member
5.	Shri P.R. Leopold, TO (T-9)	-	Member
6.	Shri N. Viswambharan, AO	-	Secretary (Official side)

Staff side

(a) Technical Category

1. Shri M.G. Sivadasan, TO(T-5) & Secretary (Staff side). CMFRI, Kochi
2. Shri S. Haja Najeemudheen, TO (T-5), CMFRI, Kochi
3. Shri H. Kather Batcha, STA (T-4), Madras R.C. of CMFRI, Chennai
4. Shri S. Rajapackiam, STA (T-4), Madras R.C. of CMFRI, Chennai

(b) Administrative Category

1. Shri N. Govindan, AAO, Madras R.C. of CMFRI, Chennai
2. Shri V.C. Subhash, Assistant & Member (CJSC of ICAR), CMFRI, Kochi
3. Shri A.K. Kunjipalu, UDC, CMFRI, Kochi

(c) Supporting Category

1. Shri Joseph Mathew, SSG-1 (Gestetner Operator), CMFRI, Kochi
2. Shri T. Vijayakumar, SSG-III (Messenger), CMFRI, Kochi
3. Shri N. Ramakrishnan, SSG-II (LA), MRC of CMFRI, Mandapam Camp

The term of the members of the Institute Joint Staff Council is for a period of 3 years from 17.11.2005.

Participation of Scientists in conferences, meetings, workshops, symposia and training in India and abroad

Prof. (Dr.) Mohan Joseph Modayil, Director participated in the following meetings

Summer Camp on Coastal Zone Awareness Camp for school children at St. Mary's H.S. Auditorium, Chellanam and gave felicitations (1 April).

IX IJSC of CMFRI at CMFRI, Kochi (5 April).

Fisheries Development Masterplan (Road Map) meeting at CMFRI, Cochin (20-21 April).

Meeting convened for Coastal Fisheries Research and Development and to prepare a Master Plan for Fisheries R&D in Karnataka under the chairmanship on the V.C., KVFSU, Bidar (23 April).

Discussion on Compilation of Report on Impact of Tsunami at KSCSTE, Pattom, Trivandrum (28 April).

Meeting for preparation of Andaman Fisheries Development Master plan at CMFRI Cochin (7 May)

SRC Meeting of CMFRI (24-28 May).

Meeting of National Coastal Zone Management Authority at MoE&F, New Delhi (8 June).

Foundation Laying function of the proposed CIFT Trainees Hostel at CIFT Residential Campus, Perumanoor (2nd July).

Participated in ANDFISH - A Roadmap for Fisheries Development in A&N Islands and made presentation at Port Blair (5th July).

Fish Farmers Day at Visakhapatnam (10th July).

National Seminar on Biodiversity Conservation & Management and delivered the Presidential Address at Malankara Catholic College, Kaliakkavilai, Kanyakumari District (22nd July).

2nd meeting of the Committee to study the Impact of Closed Season on Fishing at the Directorate of Fisheries, Bangalore (23rd July).

Meeting at SMD, New Delhi (30th August).

Selection Committee as nominee of DG at ASRB, New Delhi (5th, 14th & 21st September).

10th meeting of the National Committee on Introduction of Exotic Aquatic Species in Indian Waters at KAB, New Delhi (19th October).

Meeting in ASRB, New Delhi (20th - 21st October).

2nd meeting of the Committee constituted for modifying the proforma form Sr. Scientist to Principal Scientist under Career Advancement Scheme at ASRB, New Delhi (3rd - 4th November).

7th Indian Fisheries Forum organized by the Asian Fisheries Society, Indian Branch at Bangalore (8th - 13th November).

Committee to review the existing system of ARS/NET Examination and to suggest reforms at ASRB, New Delhi (14th November).

Interaction meeting convened by Hon'ble Union Minister for Agriculture with Indian Fisheries Sector at Chennai (16th - 17th January 2006).

Brain Storming session on "Challenges in fisheries resources conservation and utilization in relation to emerging fish biodiversity regulation of BDA 2002" at Lucknow (28th January).

Scientific Advisory Committee Meeting of M/s Kemin Nutritional Technologies at Chennai (7th February).

National Seminar on "Sustainability of seafood production : reflections, alternatives and environmental controls" organized by Society for Indian Ocean Studies at NIO, Goa (23rd and 24th February).

FAO/NACA/China Regional Workshop "The future of mariculture : A regional approach for responsible development of marine farming in the Asian-Pacific Region" at Guangzhou, China (6th -11th March).

Review Committee meeting of existing ARS/NET Examination System at ASRB, New Delhi (23rd - 24th March).

Scientists of the institute participated in the following conferences, meetings, workshops, symposia and training programmes

National Consultation on Marine Fisheries organized by National Commission on Farmers and Bay of Bengal Programme at Vishakhapatnam (2nd and 3rd May 2005). (Presented a paper entitled *Fish production trends from coastal waters of India: approaches towards sustainable exploitation*- ***Dr. N.G.K. Pillai***.

Meeting on 'Preparation of Cochin Corporation Master Plan' at EMS Memorial Town Hall, Kochi (2nd July). ***Dr. N.G.K. Pillai***.

Interface meeting between DAHD&F-CMFRI-CIFT-FSI-CIFNET-IFP at CMFRI, Cochin (20th August). ***Dr. N.G.K. Pillai***. ***Dr.E.V Radhakrishnan, Dr.M. Rajagopalan***

Two day Seminar on 'Information Technology in Fisheries' organized by the Computer Society of India, Cochin Chapter at CMFRI, Cochin (1st-2nd September). ***Dr. N.G.K. Pillai***.

Regional Workshop on 'Impact, Adaptation and Vulnerability of Fisheries and Livestock to Climate Change' at Central Plantation Crops Research Institute, Kasaragod (22-23rd September 2005) organized by Project Team at CPCRI. - ***Dr. N.G.K. Pillai, Dr.M. Rajagopalan and Dr. E. Vivekanandan***

Delivered two lectures on 'Pelagic fisheries resources of India and Straddling and migratory stocks and their fisheries' in the training programme conducted by MPEDA, Kochi (29th & 30th September). ***Dr. N.G.K. Pillai***.

Attended International Seminar on Ornamental Fish Breeding Farming and Trade, organized by Department of Fisheries, Govt. Of Kerala in association with Ministry of Agriculture, Govt. of India at Kochi (5-6 February 2006) - ***Dr. N.G.K. Pillai, Dr.E.V Radhakrishnan, Dr.M. Rajagopalan, Dr.G. Gopakumar, Shri. Boby Ignatius and Smt. Rekha J. Nair***

Seminar on 'Fisheries of Faroe Islands' organized by Royal Danish Embassy, New Delhi in connection with the visit of HE Mr. Joannes Eidesgaard, Prime Minister of Faroe Island on 2nd March 2006, Hotel Taj Malabar, Cochin- ***Dr. N.G.K. Pillai, Dr.E.V. Radhakrishnan, Dr.M. Srinath and Dr.R. PaulRaj***

Workshop on 'Impact, Adaptation and Vulnerability of Fisheries and Livestock to Climate Change' at Central Inland Fisheries Research Institute, Barrackpore, Kolkata (4th March 2006) organized by Project Team CIFRI, Barrackpore- ***Dr. N.G.K. Pillai, Dr. M. Rajagopalan***

'The International Aqua Show 2006' meeting called by the Minister for Fisheries and Sports, Government of Kerala to discuss on the conduct of International 'Aqua Show 2006' scheduled to be held from 2 to 7 February 2006, 20 December. - ***Dr. N.G.K. Pillai***

38th Meeting of the Town Official Language Implementation Committee, Mangalore at Conference Hall, Corporation Bank, Head Office, Mangalore, 31 May - ***Dr. C. Muthiah***

Meeting on 'Sea water Farming for coastal area prosperity' at M.S. Swaminathan Research Foundation, Chennai, 2 April - ***Dr. H. Mohamad Kasim***

Stakeholders' Consultation Workshop on 'Sustainable Livelihood Rehabilitation project for Tsunami affected rural communities of Tamil Nadu' at M.S. Swaminathan Research Foundation, Chennai, 4-5 April - ***Dr. H. Mohamad Kasim***

Delivered a lecture on 'Fishery Resources – Commercially important fishes of Tamil Nadu' on 16th June 2005 at Fisheries Staff Training Institute, Chennai - ***Dr. H. Mohamad Kasim***.

Income Generation Workshop cum Training Programme on 'Seaweed/Crab /Mussel/Oyster culture in Pulicate Lake in the Wild Life Office', Pulicat organized by Aquaculture Foundation of India in collaboration with PREPARE, 2–3 July - ***Dr. H. Mohamad Kasim***.

Consultative meeting on 'Coastal conservation, enterprise and livelihoods at Rameswaram' organized by the Convenant Centre for Development and the Ford Foundation 10-12 July - ***Dr. H. Mohamad Kasim***.

Millenium lecture on 'Fish for All' by Dr. Modadugu Vijay Gupta, 2005 World Food Prize Laureate at M.S. swaminathan research Foundation, Chennai, 27th September - ***Dr. H. Mohamad Kasim***.

Meeting to discuss the sanitary import conditions on fish and fishery products for the committee on risk analysis at Aquaculture Authority, Chennai, 29 September, - ***Dr. H. Mohamad Kasim***.

Technical Consultation Meeting to discuss the issue alternate species for shrimp aquaculture and on import of brood stock of indigenous species of shrimp at Chennai under the chairmanship of Joint Secretary (Fisheries), Department of Animal Husbandry, Dairying & Fisheries, New Delhi, 30th September - ***Dr. H. Mohamad Kasim***.

Brainstorming session on Disaster Management in Fisheries and aquaculture at the National Institute of Disaster Management, New Delhi, 6-7th October - ***Dr. H. Mohamad Kasim***.

First Field Demonstration on 'Mud crab farming at Goush Basha Mud Crab Farm, Gurithipalayam in Andhra Pradesh' jointly organized by AFI and M/s. Periyar Mud crab hatchery, 22 October- ***Dr. H. Mohamad Kasim***.

Meeting at State Fisheries Department to discuss issues concerned with lobsters fishing and implementation of regulation on fishing of lobsters, 24 October 2005- ***Dr.E.V. Radhakrishnan and Dr. H. Mohamad Kasim***

Workshop on Post Tsunami Rehabilitation and Fishing Communities, organized by TRINet (Tsunami Rehab Information Network), Chennai - ***Dr. H. Mohamad Kasim***.

Participated as District level supervisor for the Prakasham district, AP in the *Marine Fisheries Census 2005* from 10th April to 13th May 2005 - ***Dr. P. Jayasankar***

Training programmes on 'Strategies for Stress Management' at NAARM, Hyderabad 17-23 November - ***Dr. H. Mohamad Kasim***.

Panel discussion on the topic 'Effect of climate change on the loss of false trevally (*Lactarius lactarius*) fishery and dependent fishermen in southeast coast of India' by WWF India secretariat, New Delhi at M.S. Swaminathan Research Foundation (MSSRF), Chennai, 5th December - ***Dr. H. Mohamad Kasim***.

'The XX meeting of ICAR Regional Committee No. VIII' at the Conference Hall of IMAGW, Chennai, 23-24 December - ***Dr. H. Mohamad Kasim***.

Seminar on 'Conservation of Marine biodiversity of Gulf of Mannar and Palk Strait and opportunities for livelihood support of coastal communities' organized by National Biodiversity Authority, Government of India, Chennai and Aquaculture Foundation of India, Chennai at Ramanathapuram (17th – 18th December)-***Dr. G. Gopakumar* and *Dr. H.M. Kasim***

Joint Hindi Workshop conducted by TOLIC ion connection with the Hindi Month celebrations at Staff Training centre, Corporation bank (24th August)- ***Dr. Prathibha Rohit***

Participated and presented a paper in the ICAR Network Project workshop on "Impact of climate change on the socioeconomics in the marine fisheries sector" conducted at CPCRI, Kasaragod during September 22-24, 2005 –***Dr. E. Vivekanandan***

Attended the Interactive workshop on the preparation of roadmap for the development of fisheries in Andaman-Nicobar Islands on 20th and 21st April 2005 – ***Dr.E.V. Radhakrishnan,Dr. M. Rajaopalan and Dr. S. Sivakami***

Attended meeting with the members of National Fisheries Development Board on 24-5-2005 – ***Dr. S. Sivakami and Dr.E.V. Radhakrishnan***

Participated in the Seminar on "Fisheries Export Value Addition" organized by the Veraval Industries association, Veraval, 14th July, 2005 – ***Dr. K.V.Somasekharan Nair***

19th Regional Committee Meeting of Regional Committee No: VI at CSSR, Karnal, Haryana, 2nd & 3rd September, 2005 – ***Dr. K.V.Somasekharan Nair***

Participated in the Lobster Conservation Workshop jointly organized by CMFRI and MPEDA at Veraval (21st and 22nd November 2005). A rally of the stakeholders was also organized at Veraval with wide publicity for general awareness among the masses about the need to conserve the natural resources – ***Dr.E.V. Radhaskrishnan, Dr. K.V.Somasekharan Nair, Dr.P.K. Asokan and Shri. Joe K. Kizhakudan***

Attended the Workshop on "Ecosystem based Fisheries Management" at Mumbai (16th to 18th November, 2005) – *Dr. K.V.Somasekharan Nair,* ***Dr.P.K. Asokan, Dr.V.V. Singh and Dr. V.D. Deshmukh***

Participated in the 2nd Meeting of Fishery Science, Production & Health Sub-committee of AGRESCO, 13th – 14th February, 2006 at Junagadh- ***Dr. K.V.Somasekharan Nair***

Attended the brainstorming session on "Open sea mariculture in India" held on 23rd August 2005 at National Institute of Ocean Technology, Chennai- ***Dr. G. Mohanraj***

Attended the workshop on "Strategy and preparedness for trade and globalization in India with regard to fisheries sector" on 6th October 2005 at Chennai which was jointly organized by MPEDA and Seafood Exporters Association of India (SEAI) under the United Nations Conference on Trade And Development (UNCTAD) - ***Dr. G. Mohanraj***

Attended the Review meeting of the DOD funded project "Studies in marine mammals from the Indian EEZ and the contiguous seas" at Chennai during 6th – 8th July 2005 - ***Dr. P. Jayasankar***

Attended the Seventh Indian Fisheries Forum Sessions held between 8th and 12th November, 2005 at Bangalore and presented papers - *Dr. G. Mohanraj,* ***Dr.E.V. Radhakrishnan, Dr.G. Nandakumar, Dr. P. Jayasankar, Shri. A.P. Dineshbabu, Smt.S. Lakshmi Pillai, Dr. Vipinkumar V.P, Dr. Rani Mary George, Dr.C. Ramachandran, Dr.P.K. Krishnakumar, Dr.K.S. Mohamed, Dr.P. Laxmilatha, Dr.K.K. Vijayan, Dr.K.S. Sobana and Dr.P. Vijayagopal***

Attended workshop on Ecological grouping for northwest coast at Mumbai Research Centre of CMFRI, Nov 2005 – ***Shri. S.G. Raje***

Workshop on conservation of lobsters organized by CMFRI at CIFE, Mumbai on 28.11.2005– ***Dr.E.V. Radhakrishnan, Dr. V.D. Deshmukh, Dr.M. Zaffar khan, Shri. S.G. Raje, Dr.V.V Sigh, Dr. Miriam Paul and Dr. Paramita Banerji***

Attended as panel export on fisheries development for Kasaragod District and gave suggestions for development of marine fisheries sector in the District study congress held at Municipal Town Hall, Kasaragod on 30-7-2005 - ***Dr.P.U.Zacharia***

Attended a meeting to discuss on implementation of the consultancy project "Survey, inventorying and database creation of marine and coastal aquatic biodiversity in the three coastal districts of Karnataka" at Karnataka Biodiversity Board, Bangalore on 26th Aug 2005 and made a presentation - ***Dr.P.U.Zacharia***

Attended state level workshop on Ichthyofaunal biodiversity in aquatic ecosystems of Karnataka and presented a paper on "Icthyofaunal biodiversity in marine systems of Karnataka" on 27th October 2005 at College of Fisheries, Mangalore - ***Dr.P.U.Zacharia and Smt. Sujitha Thomas***

Associated with two three-day training workshops on use of Ecopath with Ecosim software for trophic modelling of marine ecosystems for the project associates of Veraval and Mumbai at Mumbai Research centre of CMFRI during 17-19 November 2005; for the project associates of Mandapam and Tuticorin at Tuticorin Research centre of CMFRI during 28-30 November 2005 - ***Dr.P.U.Zacharia***

Worked as district-level supervisor for North Karnataka and Goa in connection with the All India Marine Fisheries Census during April-May 2005 - ***Dr.P.U.Zacharia***

Attended QRT meetings on 18-19 September 2005 and 26.11.2005- ***Dr. E.V. Radhakrishnan, Dr. E.Vivekanandan and Dr.K.S. Mohamed***

Participated in delivering lectures on 'Crustacean Fisheries resources of India' on 28.9.2005 and on 'Prospects for stock enhancement' on 29.9.2005 at MPEDA - ***Dr.E.V. Radhakrishnan and Dr.R. Sathiadhas***

Presentation on crab culture for officers of State Bank of India, Fort Cochin on 2.12.2005- ***Dr.E.V. Radhakrishnan***

Attended and presented a paper on 'Live transport and marketing of crustaceans' in National Seminar in Hindi at CIFT, Cochin on 21.12.2005- ***Dr.E.V. Radhakrishnan***

Attended the meeting in connection with the visit of the World Bank team on 14.7.2005 at CMFRI to discuss on the concept notes for NAIP projects- ***Dr.E.V. Radhakrishnan, Dr.N.G.K. Pillai, Dr.R. Sathiadhas, Dr.P.K. Krishnakumar and Shri.K.K. Philippose***

Marine Fisheries Census work as district level supervisor, Jagat Singhpur district and Kendrapara district of Orissa state– ***Dr.G.Maheswarudu***

Attended the technical session "Towards Diversification of Aquaculture" conducted by Fishing Chimes award function on 10.7.2005 at Visakhapatnam – ***Dr.G.Maheswarudu.***

Attended the workshop on "Tuna resources" organized by Fishery Survey of India, at Visakhapatnam on 20.7.2005 – ***Dr.G.Maheswarudu***

Attended media workshop on Integrated Coastal Zone Management organized by the Hindu Media Resource Centre (HMRC) of Ms Swami Nathan Research Foundation, Chennai on 25.2.2006 at Visakhapatnam – ***Dr.G.Maheswarudu.***

Delivered a talk and interacted with fishermen at Pudimadaka village in connection with the awareness campaign on Responsible Fisheries on 3.3.2006– ***Dr.G.Maheswarudu***.

National Seminar on Biodiversity Conservation and Management, 22-23 July, 2005 at Department of Biotechnology, Malankara Catholic College, Mariagiri and presented papers - ***Dr.E.V.Radhakrishnan, Dr. Rani Mary George and Smt. Rekha J. Nair***

National Hindi Seminar on 'Livelihood issues in fisheries and Aquaculture' held at CMFRI, Cochin on 3.3.2006 and presented papers- ***Dr.E.V.Radhakrishnan,Dr. R. Sathiadhas, Dr.L. Krishnan, Dr.G.Nandakumar, Dr. Mary K. Manisseri, Dr. P. Jayasankar, Dr. P. Kaladharan, Dr. K. Madhu, Dr. Rema Madhu, Dr.P.C. Thomas, Shri. Boby Ignatius, Dr. Rani Mary George, Dr.V. Chandrika, Smt. T.S. Naomi, Smt. Rekha J. Nair and Shri. N.K. Sanil***

Attended a Workshop on "Prevention of atrocities against women" organized by the Ernakulam District Level Committee of Police, on 05.11.2005 - ***Dr. Mary K. Manisseri and Dr. Rani Mary George***

Winter School (CAS Training programme) on Advances in Disease Diagnostics for Finfish and Shellfish Health Management at Central Institute of Fisheries Education, Mumbai from 15 November to 5 December, 2005-***Dr. E. Dhanwanthari***.

Delivered a talk on problems and prospects of crab culture in a training programme conducted by BFFDA, Kannur on 29.9.05 – ***Smt. P.T. Sarada***

The Conference on Ornamental fish export organized by Marine Products Export Development Authority of India and INFOFISH at Kochi on 4 April 2005 – ***Shri. K.K. Philippose***

Participated in the Malayala Manorama Seminar "Kalaminoppam Kalathinoppam" organize3d by the Malayalam daily Malayala Manorama to prepare Developmental plans for the fisheries sector in Kerala based on the 10-point Developmental plan proposed by the honorable President of India, at Nila Palace, Cheerankavu, Kollam on 3.12 2005. – ***Shri. K.K.Philippose and Dr. K.K. Appukuttan***

Participated in the workshop on 'The role of Public-private co-operation in the Management of estuaries in Kerala, India. On 27th, 29th October, 2005 at Kumbalangi, Kochi organized by School of Industrial Fisheries, CUSAT, Kochi and Natural Research Institute, University of Manitoba, Canada –***Dr. K.K. Appukuttan***

Front-line demonstration-cum-training programme on *Kappaphycus* farming to the mussel farmers of Kasargod district on 21-12-2005 organised by the Green Mussel Farmers' Society-***Dr.K.S. Mohamed***

Stakeholders workshop regarding ANDFISH – A roadmap for fisheries development in A&N Islands at CARI, Port Blair during 5-6 July 2005 -***Dr.K.S. Mohamed***

DFID funded project meeting on Capacity building in the use of FMSP stock assessment tools and management guide line, planning workshop on 'Fisheries stock assessment capacity building' 9-13th May 2005 at Visakhapatnam as a resource person – ***Dr.G. Syda Rao***

Consultative committee meeting of Vizag base of FSI on 7.7.2005 – ***Dr.G. Syda Rao***

Workshop on validation of Stock assessment tools developed by DFID at Kolkata 8-12th August, 2005 – ***Dr.G. Syda Rao***

Workshop on strategy and preparedness for trade and globalization in India with regard to Fisheries sector. Organised by MPEDA, SFEAI and UNCTAD at Vizag on 4-10-2005 – ***Dr.G. Syda Rao***

Attended Training workshop on of Ecopath modeling, 28 – 30 November, 2005, CMFRI, Tuticorin- ***Shri. V. Venkatesan***

National Marine Fisheries Census 2005 meeting conducted by Department of Animal Husbandry, Dairying & Fisheries and CMFRI, Cochin on 15th April 2005 at CMFRI, Cochin –***Dr.M. Rajagopalan***

Attended the Expert Committee meeting for Studying and Reviewing Impact of Tsunami on Ocean Ecosystem and its resources at NIO, Kochi during 17-19 July 2005 organized by Director, INCOIS, Hyderabad –***Dr.M. Rajagopalan***

Attended the Working Group meeting of National Agricultural Innovative Project (NAIP) and made a presentation on 'Bioprospecting the marine biota for novel genes, bioactive molecules and products' at NASC, New Delhi on 19th September 2005 - ***Dr. P. Jayasankar***

Delivered a lecture entitled "Applications of Biotechnological Tools in Animal Sciences" on 2nd February 2006 at S.H College, Thevara - ***Dr. P. Jayasankar***

Attended meeting for the 'Integrated Fisheries Development of Lakshadweep' organized by CMFRI, Cochin during 3rd August 2005 –***Dr.M. Rajagopalan, Dr.E.V. Radhakrishnan, Dr. N.G.K. Pillai, Dr. E. Vivekanandan and Dr.K. S. Mohamed***

Attended the Consultancy Project Evaluation Meeting at Karnataka Biodiversity Board, Bangalore on 5th August 2005 –***Dr.M. Rajagopalan***

Conducted the Scientific Advisory Committee Meeting on KVK, CMFRI at CMFRI, Cochin on 12th August 2005 on behalf of Director –***Dr.M. Rajagopalan***

Attended the workshop "Independent Evaluation and Impact Assessment of Krishi Vigyan Kendras" representing CMFRI at KVK Pondicherry during 23-25 August 2005 –***Dr.M. Rajagopalan***

Attended the finalization of DOD projects for XI Plan organized by CMLRE, DOD at Cochin on 7th October 2005–***Dr.M. Rajagopalan, Dr.E.V. Radhakrishnan, Dr. E.Vivekanandan and Dr.N.G.K. Pillai***

Presented the achievements and results of the DOD Funded Project "Studies on marine mammals" in the Scientific Advisory Committee meeting held on board FORV *Sagar Sampada* at Cochin during 24-25 November 2005–***Dr.M. Rajagopalan***

Attended the National Convention on 'Knowledge Driven Agricultural Development: Management of Change organized by ARSS Forum and ICAR, New Delhi during 24-26 March 2006–***Dr.M. Rajagopalan***

National seminar on 'Wet Land Biodiversity' at St.Allsius College Elthuruth organized by Limnological Association of Kerala-***Dr.J.P. George***

Workshop at CUSAT on "Conservation of Kerala Mangroves".Attended the environmental congress conducted by CED, Trivandrum at Town Hall Ernakulam and chaired a session. -***Dr.J.P. George***

Conducted and successfully completed field survey for "All India Marine Fisheries Census 2005" funded by Dept. of Animal Husbandry, Dairying & Agriculture, Govt. of India, from 12.04.2005 to 09.05.2005 as District Supervisor for Sindhudurg District of Maharashtra and also conducted training programmes for enumerators at Malvan, Vengurla and Devgad talukas on 12th, 13th & 14th April 2005 respectively –***Dr.V.V. Singh***

Delivered a lecture on 18.05.2005 to the participants of the training programme on "Farm layout, design and instrumentation" organized at the Central Institute of Fisheries Education (Deemed University), Mumbai during 16-30 May 2005–***Dr.V.V. Singh***

Attended a preliminary meeting on 16.06.2005 with the officials of the Nuclear Power Corporation Limited (NPCL), Mumbai on seismic activities and fisheries –***Dr.V.V. Singh***

Attended a meeting of the expert committee to reorganize the course curriculum for "Diploma in Aquaculture" held on 06.07.2005 at the Indira Gandhi National Open Univeristy, New Delhi–***Dr.V.V. Singh***

Attended a meeting held at Nuclear Power Corporation Limited (NPCL) on 12.07.2005 at Mumbai to discuss modalities for the proposed project on "Integrated hazard risk management with special reference to seismic activities, marine environment and fisheries along the coast of India" –***Dr.V.V. Singh***

Participated and interacted in round table discussions on 03.10.2005, at Indo-American chamber of commerce, Mumbai, organized by United States Environmental Resource Centre (US-ERC) to discuss regional initiative in South Asis aimed at promoting greater participation of the private sector in coastal conservation during the visit of Ms Katherine Koch – the Director – Regional Environment Office for South Asia–***Dr.V.V. Singh***

Attended brainstorming session on 30.12.2005 at NEERI Laboratory, Mumbai regarding project on post commissioning impact of sewage outfall operations along the west coast of Mumbai–***Dr.V.V. Singh***

Participated in the National Seminar on "Sustainability of Seafood Production: Reflections, Alternatives and Environment Control" organized by "Society for Indian Ocean Studies" at NIO Goa from 23.02.06 to 24.02.06–***Dr.V.V. Singh***

As District Supervisor, carried out training of personnel and coordinated the census work in Balasore and Bhadrak Districts of Orissa during April-May 2005 spending about 30 days (15th April to 16th May 2005)-***Dr.K. Vijayakumaran***

Attended a Network Project Workshop on "Approaches to economic impact assessment of climate change on agriculture" during 13-15th February 2006 at Water Technology Centre, Tamil Nadu Agricultural University, Coimbatore -***Dr.K. Vijayakumaran***

Attended the International training workshop on 'Marine Food Security' organized by the United Nations Institute for Training and Research (UNITAR), Hiroshima office for Asia and the Pacific (HOAP), in Hiroshima, Japan during 26-30 September 2005-***Dr.P.K. Krishnakumar***

Attended the 1st Nethravathi River Basin Stakeholders Meet in the Deputy Commissioner's office at Mangalore on 22nd October 2005 and given a presentation on "River discharge and productivity of the coastal waters" -***Dr.P.K. Krishnakumar***

Attended as resource person in the ICAR sponsored short-term course on "Coastal and marine environmental management" organized by the College of Fisheries Mangalore on 25th October 2005 and a presentation was given on "Status of marine pollution in India" -***Dr.P.K. Krishnakumar***

Conducted Marine census as District Supervisor for 2 districts – Krishna and Guntur in Andhra Pradesh during 15th April to 15th May 2005. the duties include training enumerators, supervising data collection, payment to the enumerators, filled up schedules despating to the HQ-***Dr.P. Kaladharan***

Attended meeting on "Assessment of Gulf of Mannar Coral Reef Health using satellite data" held at GEF trust office Ramanathapuram by Dr. Anjali of Space Application Centre of ISRO on 11.05.2005-***Smt. Bindu Sulochanan***

Attended 93rd Indian Science Congress held at Hyderabad during 3rd to 7th January 2006 - ***Dr. P. Jayasankar***

Training on Management Development Programme (MDP) on Intellectual Property Rights (IPR) in Agricultural, from 26th – 30th July 2005 at National Academy of Agricultural Research management (NAARM), Rajendra Nagar, Hyderabad-***Dr.K.K. Vijayan***

Attended a special session by SAP 'Shrimp health management with special reference to viral disease problems in India' in the 7th Indian Fisheries Forum organized by the Asian Fisheries Society Indian Branch at Inland Fisheries Division, Karnataka Veterinary, Animal & Fisheries Sciences University, Hebbal, Bangalore during 8th to 12th November, 2005-***Dr.K.K. Vijayan***

Resource person for the training programme on DNA Fingerprinting organized at NBFGR ,Cochin unit-***Dr.P.C. Thomas, Dr. P. Jayasankar***

Biodiversity Awareness Workshop organized by the National Biodiversity Authority of India at CTCRI, Trivandrum on 10th and 11th 2006. Delivered an invited talk on Marine Biodiversity – its Conservation and Utilization-***Dr. A.P. Lipton***

National Seminar on Biomedicine in Aquaculture at CMST, Kanyakumari held on 17th and 18th March 2006: Delivered a Lead Talk and presented a paper-***Dr. A.P. Lipton***

National Seminar on Bio-trends organized under the aegis of the Biotechnology Integrated Research and Development (BIRD) of the Department of Biotechnology, Udaya School of Engineering, Vellamodi on 25-3-2006. Delivered a special talk and chaired the Session on 'Marine Biotechnology'-***Dr. A.P. Lipton***

KVK (Narakkal) - Sponsored training programme on 'Ornamental Fish Culture' was organized with 40 participants on 5-9-2005-***Dr. A.P. Lipton***

Participated in the Winter school entitled " Modern techniques for the analysis of Fish and fish products" from 17-10-05 to 8-11-05 organized by Div. of Biochemistry & Nutrition, Central Institute of Fisheries Technology, Cochin-***Shri. I. Rajendran and Dr. Kajal Chakraborty***

Attended the two-day seminar-cum-workshop on "Capacity building programme for Indian Agricultural Research, Extension development organizations in globalised Economy" sponsored by ICAR organized at NAARM, Hyderabad during 29th to 30th April 2005-***Dr.K.S. Sobhana***

Served as resource person for "Ornamental fish diseases" for the training programme on "Production and Marketing of Ornamental fishes" organized by the State Fisheries resource Management Society (FIRMA) (Govt. of Kerala) on 28/6/05- ***Dr.K.S. Sobhana***

Attended Winter School on "Aquaculture Nutrition and Production of Artificial Feeds" from 01-11-2005 to 21-11-05 organized by Fisheries College and Research Institute, Tuticorin- ***Dr. Maragaret Muthu Rethinam***

Attended the Brainstorming session held at the Mandapam Centre of CMFRI on the present status and problems of marine capture and culture fisheries of Tamil Nadun with special reference to Ramanathapuram District on 3-8-05- ***Dr. P. Vijayagopal***

Attended the Agricultural Consultative Committee meeting on 11.7.2005 at Ernakulam Dist. Co-operative Bank Building, Kakkanad- ***Dr. R. Sathiadhas***

Attended and presented socio economic issues relating to fisheries during the visit of World Bank Team during 20.10.2005-23.10.2005 -***Dr. R. Sathiadhas***

Participated in Shastri Applied Research Programme (SHARP) dissemination workshop at Kallenchery Retreat, Kumbalangi on 27th & 28th October 2005 -***Dr. Sathiadhas***

Participated in the National Seminar on " Green to Evergreen: Challenges to Extension Education" at IARI New Delhi during December 15th – 17th, 2005-***Dr. Vipinkumar.V.P***

Attended the Inter-Media Publicity Co-ordination Committee Meeting on 29.12.2005 at Doordarshan Kendra, Kudappanakunnu, Trivandrum. He also attended to review the project work of Tech.Staff of the division and collection of data on market/techno interventions for the project entitled "Impact of Management and Technological Interventions on Marine Fisheries and Coastal Livelihood" in the Tuticorin Coast-***Dr. R. Sathiadhas***

Attended Consultative workshop on 'Diaster Management in Fisheries and Aquaculture' during 6-7th October,2005 at NIDM, New Delhi- ***Shri. I. Jagadis***

Attended a training programme on 'Diaster Management for Fisheries sector Scientists during 30th Jan- 3rd Jan 2006 at NIDM, New Delhi- ***Shri. I. Jagadis***

Attended a training programme on "Leadership and personality development" at NAARM, Hyderabad from 17.06.2005 to 23.06.2005-***Dr. Rani Mary George***

Attended a training programme on "Use of Ecopath with Ecosim software for Trophic Modelling of Marine Ecosystem" 28.11.2005 – 30.11.2005 at TRC of CMFRI-***Dr. K. K Joshi***

Attended a training programme on 'Indroduction to GIS at NRSA, Hyderabad from 12.9.05 to 17.10.05-***Dr. Miriam Paul Sreeram***

Attended "Training on DNA Fingerprinting" during 6.3.2006 to 16.3.2006 at NBFGR, Cochin-***Dr. Rani Mary George and Smt. Rekha J. Nair***

Participated in the "National Workshop on Applications of Informatics in Marine Biodiversity Conservation, 5 -7 December 2005 at NIO, Goa, conducted by NIO, Goa and DBT, Delhi-***Smt. Sujitha Thomas and Smt. Rekha J. Nair***

Attended a meeting on the collaborative research program on Fish germplasm exploration, cataloguing & conservation at NBFGR, Lucknow on 27th January 2006 - ***Dr. P. Jayasankar***

Attended a brainstorming session on "Challenges in fisheries resources conservation and utilization in relation to emerging biodiversity regulations" at NBFGR, Lucknow on 28th January 2006 - ***Dr. P. Jayasankar***

Attended a training on fish germplasm exploration and taxonomy at NBFGR, Lucknow during 29th January – 1st February 2006 - ***Dr. P. Jayasankar***

Attended a National Seminar in Hindi on 'Livelihood issues in Fisheries and Aquaculture' at CMFRI, Cochin and made a presentation in Hindi on 'Ornamental Fish Culture' on 3rd March 2006 - ***Dr. P. Jayasankar***

Functioned as faculty in a training course on "DNA Fingerprinting" conducted by the NBFGR, Cochin Unit and delivered two lectures, one on 'AFLP fingerprinting' (10th March) and the other on 'Cetacean molecular taxonomy' (15th March) - ***Dr. P. Jayasankar***

Workshops Seminars Summer Institutes and Farmer's Day Organised

The Workshop on participatory management at Mumbai

The lobster conservation workshop at Veraval

- Organized two workshops by Crustacean Fisheries Division on lobster conservation under the MPEDA funded project 'Participatory management and conservation of lobster resources along the Indian coast during 21-22nd November, 2005 at Veraval and on 28th November, 2005 at Mumbai. 200 participants representing fishermen Societies and Association, NGO's, fish traders, Seafood exporters, State Fisheries Departments, Scientists and Officials from CMFRI, CIFT, CIFE, MPEDA, FSI and EIA participated and discussed on co-management and conservation of lobster resources. Posters, stickers, pamphlets and handouts in Gujarati and Marathi languages were distributed among the stakeholders.
- A rally to disseminate the message of lobster conservation among fishermen, traders and exporters was held on 21 November 2005 at Veraval.
- A training workshop on Molluscan fisheries resources of India and their management was organized for the benefit of MPEDA officials on 27th September, 2005.
- A training programme to women oyster farmers on 'Mussel farming'was organized by CMFRI and BFFDA, Moothakunnam, Ernakulam on 25th October, 2005.
- Conducted training workshop on Modeling of NWC Ecosystem under MF/CAP/02 to project associates in Veraval and Mumbai at Mumbai from 17th to 19th November, 2005.
- Conducted training workshop on Modeling of GOM Ecosystem under MF/CAP/02 to project associates in Mandapam and Tuticorin at Tuticorin Research Centre of CMFRI from 28th to 30th November, 2005.
- Frontline demonstrations and training programs in association with state fisheries departments and other aquaculture development agencies were conducted as a part of the project. In central Kerala 16 mussel farms including an open sea raft were set up stocking 430 mussel ropes and 18 oyster farms were set up where 5750 oyster rens were stocked by farmers. In north Kerala more than 650 coastal fishers benefited from the interactive sessions held with farmers and nearly 300 fishers have initiated mussel farming this year. Integrated farming of seaweed *K.alverazii* with mussel/shrimp was also taken up by farmers with the scientific support from the project team members. The various training and demonstration programs implemented under the project are given below:

Personnel
(Senior positions only)

Director	**Prof. (Dr.) Mohan Joseph Modayil**
Heads of Divisions	
Crustacean Fisheries Division	Dr. E.V. Radhakrishnan
Pelagic Fisheries Division	Dr. N. Gopalakrishna Pillai
Demersal Fisheries Division	Dr. E. Vivekanandan
Socio-Economic Evaluation & Technology Transfer Division	Dr. R. Sathiadhas
Fishery Resources Assessment Division	Dr. M. Srinath
Fishery Environment Management Division	Dr. M. Rajagopalan
Molluscan Fisheries Division	Dr. K.S. Mohamed
Physiology, Nutrition and Pathology Division	Dr. K.K. Vijayan
Marine Biodiversity Division	Dr. (Mrs.) Rani Mary George
Mariculture Division	Dr. G. Gopakumar
Sr. Administrative Officer	Shri K. L. Meena
Sr. Finance & Accounts Officer	Shri. G. P. Sharma
Administrative Officers	Shri N. Viswambharan Shri. Vipul Raj
Scientists-in-Charge of Regional/Research Centres	
Mandapam Camp	Dr. N. Kaliaperumal, PS
Chennai	Dr. H. Mohamed Kasim, PS
Tuticorin	Dr. A.C.C. Victor, PS
Karwar	Dr. V.S. Kakati, PS
Mangalore	Dr. C. Muthiah, PS
Veraval	Dr. K.V. Somasekharan Nair, PS
Vizhinjam	Dr. A.P. Lipton, PS
Mumbai	Dr. V.D. Deshmukh, PS
Minicoy	Shri.K.P Said Koya, Scientist (SG)
Visakhapatnam	Dr. G. Syda Rao, PS
Calicut	Dr. P.N. Radhakrishnan Nair, PS
Krishi Vigyan Kendra	Dr. P.K. Martin Thompson, Technical Officer

Official Language Implementation Activities for the year 2005-2006

Shri. B.Abraham, Wing Commander, (Rtd.) Indian Air Force, Chief Guest of Hindi Chethana Maas delivering the inaugural address

I Ongoing activities:

1. Section 3(3) documents: Cent percent bilingual issue of Section 3(3) papers is being ensured by simultaneous issue as well as following up the Hindi version (Total number 345).
2. Hindi correspondence: During the year average correspondence made to Region A, B & C was 40.1%, 37.9% and 35.3%, respectively. Hindi letters received in Hindi (Total 454) were replied to in Hindi itself.
3. Stationery items: Bilingualisation of stationery items such as rubber stamps, name plates, name boards, charts of various Divisions and ATIC, banners and plaques of various functions of the institute were prepared in bilingual form.
4. Leap Office 2000: Hindi software Leap Office 2000 is being installed in new computers of various Sections/Divisions.
5. Hindi workshops: In order to improve the efficiency of the staff in doing Hindi work, three Hindi workshops were conducted at Headquarters during the year on 1-3, 9-2005, 14-10-2005 ns 19/ 21-12-2005 in which 10 officers and 45 employees participated.
6. Hindi Chethana Maas: In order to create an enthusiastic atmosphere in Official Language activities, 'Chethana Maas' was observed at the Institute from 24 August to 23 'September, 2005. During this period various competitions such as Hindi Essay writing, Terminology, Quiz and singing were conducted.
7. Incentive scheme: Hindi Incentive Scheme cash awards were given to two officers and ten employees for their overall performance in Hindi work.
8. National Hindi Seminar: With a view to develop the use of functional Hindi and to disseminate the Scientific achievements in Hindi to the fisher folks, a National Seminar in Hindi was conducted on the subject *Livelihood issues in Fisheries and Aquaculture* on 3rd March, 2006. 18 research papers were presented in the seminar out of which 15 papers were presented by the Scientists of Headquarters and outstations. The proceedings of the seminar was also released on the occasion as a *Special Publication* No.90. The recommendations made in the plenary session were sent to ICAR and ICAR Fisheries Institutes.

II. Official Language Inspections:

1. a.ICAR inspections: Shri Rajeev Uniyal, Sr.Technical Officer, and Shri Manoj Kumar, Technical Officer, ICAR inspected the Official Language activities of Headquarters on 30-5-2005.

   b. Dr. A.D. Diwan, ADG (M,F), ICAR and team inspected OL activities of Headquarters on 23-9-2005 and 23-3-2006 and reviewed the progress achieved.

c. Shri Harish Chandra Joshi, Director (Hindi), ICAR inspected OL activities of Calicut Research Centre in January 2006.

2. Outstation inspection: Official Language Implementation activities of Mangalore, Calicut and Minicoy Research Centres were inspected by Director during the year.

3. Dr. E.V. Radhakrishnan, Head, CFD inspected the Veraval Regional Centre on 23-11-2005 and Mumbai on 27.11.2005.

4. Internal inspections: Progress achieved in the implementation activities of various Divisions/Sections/Cells were inspected by concerned inspection committees.

III. OLIC meetings: Quarterly meetings of the Official Language implementation committee of the Institute were conducted on 30-6-2005, 6-10-2005, 13-1-2006 and 23-3-2006 (special meeting) and reviewed the progress achieved in OL implementation.

IV. Awards/Recognitions:

a) Rajarshi Tandon Award: CMFRI won the Rajarshi Tandon Award year (first position) for the third consecutive year for excellent Official Language Implementation among ICAR Institutes during 2004-2005. The award was received by the Director on 27-2-2006.

b) Cochin TOLIC Award: CMFRI won the TOLIC Rajbhasha Rolling Trophy for the best Official Language Implementation for the year 2004-2005. The award was received by Sr.A.O on 25-5-2005.

c) Karwar TOLIC Award: Karwar Research Centre of CMFRI won best OL implementation award by Karwar TOLIC.

d) All India essay competition Award: Dr. George J.P, Principal Scientist won the All India Essay competition award for his paper *Conservation and Management of Mangrove biodiversity in India* by Central Hindi Secretariate Parishad, New Delhi. The award distributed on 18-11-2005 in the function organized at new Delhi.

e) TOLIC prize:

1. Shri P.P. Chandrasekharan Nair, UDC won third prize in Hindi typing competition conducted by Cochin TOLIC in connection with Hindi fortnight celebration – 2005.

2. Shri Subramanya Bhat, Technical Officer bagged first prize in Hindi Quiz and third in Hindi working knowledge, Smt. Alli C. Gupta, Technical Officer bagged third prize in Hindi Essay competition conducted by TOLIC.

V. Hindi Teaching Scheme Courses: Under Hindi Teaching Scheme courses 4 ministerial staff from Headquarters passed prabodh and pragya courses; one stenographer passed Hindi stenography and one is undergoing training. Four Technical staff of Tuticorin Research Centre also passed Praveen Course under HTS.

VI. Programmes attended: Dr. E.V. Radhakrishnan, Head, CFD attended National Hindi Seminar organized at CIFT, Cochin on 21 December, 2005 and presented a paper.

Dr. Mohan Joseph Modayil, Director receiving the Rajarshi Tandon Award for best Hindi Implementation in ICAR Institutes from Sri. Ratnakar Pandey

Dr.(Smt.) C.P. Suja and Manickaraja, Technical Officers attended two days Hindi workshop conducted by Heavy water plant, Tuticorin on 21 and 22nd December, 2005.

VII. Papers published: The following research articles in Hindi were published in Krishi Chayanika, Research Publication of ICAR.

1. Increasing demand for marine biofeed-Dr. E.V. Radhakrishnan, Principal Scientist and Head, CFD.
2. Importance of Mangroves in India- Dr. George J.P, Principal Scientist.
3. Marine capture fisheries in India - Smt. Mini K.G., Scientist.

VIII. Purchase of Hindi books: During the year Rs. 42,359/- was spent for the purchase of Hindi books for the Institute.

IX. Periodicals / publications released bilingually/ in Hindi.

a. Quarterly periodicals: MFIS No. 183,184 and 185.

CMFRI newsletter No. 105, 106, 107 & 108 were published bilingually and Annual Report was published with Hindi summary.

b. Special publication 1) CMFRI Special Publication *Matsyagandha*

c. CMFRI Special PublicationNo.90. Matsiki aur jalkrishi mai jeevikoparjan masle.

d. Extension pamphlets: Two extension pamphlets – 'swayam sahayak sangh' and pank kekada were released in Hindi.

e. Hindi Book: Hindi book 'Apraphya thak pahunchna' was published during the year

X. Abstracts of thesis: During the year 5 abstracts of theses of MFSc students were prepared in Hindi.

XI. Future programme: Release of glossary on Fishery terminology being used in Institute.

Smt. Minnie Mathew, Chairperson, Coconut Development Board, Cochin releasing the Special Publication *Matsyiki aur jalkrishi mei jeevikoparjan masle* during the inauguration of the Hindi Seminar

Distinguished Visitors

Headquarters, Kochi

- Shri Pankaj Kumar Bansal, IAS, Addl. Director, Fisheries, Govt. of Tamil Nadu
- Dr. K.L. Chadha, Ex. DDG (Hort.), National Professor (Retd.), ICAR, New Delhi.
- World Bank team
- Dr. G. Subramanian, Professor of Bharathidasan University, Tiruchirapalli (QRT member)
- Prof. Amalesh Chaudhary, Ex. Professor of Calcutta University (QRT member)
- Dr. L.S. Valsala, Professor, Community Medicine, Amritha Institute of Medical Sciences (AIMS), Cochin
- Dr. S.L. Mehta, Vice Chancellor, Maharana Pratap University of Agri. & Technology, Udaipur
- Dr. S.A.H. Abidi, Ex-Member ASRB, New Delhi
- Dr. A.G. Sawant, Ex-Member, ASRB, New Delhi
- Dr. H.P. Singh, Vice-Chancellor, RAU, Pusa, Bihar
- Shri Abdullah Kamaludeen, Hon'ble Minister of Fisheries, Maldives
- Dr. Mohamed Shriramm Adam, Executive Director, Marine Research Centre, Maldives
- Dr. Abdulla Naseer, Executive Director, Marine Research Centre, Maldives
- Prof. M.S. Swaminathan, Chairman, National Commission on Farmers, Govt. of India & Chairman, MSSRF, Chennai.
- Shri Joannes Eidesgaard, Prime Minister of the Faroe Islands and team

Dr. M. S. Swaminathan, Chairman, National Commission of Farmers on a visit to Headquarters

Visakhapatnam Regional Centre

- Dr. A.D. Diwan, Assistant Director General (M.Fy.), ICAR, New Delhi
- Shri Ajay Bhattacharya, Joint Secretary, Ministry of Agriculture, Krishi Bhavan, New Delhi
- Shri A.J. Banga, Director, Department of ADF, Ministry of Agriculture, New Delhi
- Dr. M. Sakthivel, President, AFI
- Dr. G. Santhana Krishnan, Joint Director, MPEDA, Cochin
- Dr. Jayaram, Joint Director, Department of Fisheries, Bangalore
- Shri Chakraborthy, Joint Director, Government of West Bengal
- Shri Arjun Nayak, DDF, Government of Orissa
- Shri P.C. Appa Rao, President, AP Mechanised Boat Owners Association
- Shri A.S. Bhatia, Under Secretary, ICAR, New Delhi

- Students from Adarsh Talent School and St. Josephs College for Women, Visakhapatnam
- Dr. M.V. Rao, Former ADG, ICAR

Mandapam Regional Centre

- Shri B.L. Jangira, Director (Finance), ICAR, New Delhi
- Mr. S. Rajeswaran, IPS, DIG of Police, Madurai
- Mr. R. Krishnamurti, Chief Engineer (SZ 1), CPWD, Chennai
- Shri A.S. Bhatia, Under Secretary (Fy.), ICAR, New Delhi
- Shri Ravi Prakash, Protocol Officer, ICAR Headquarters, Krishi Bhavan, New Delhi
- Prof. S. Kannaiyan, Chairman, National Biodiversity Authority, Govt. of India, Chennai

Veraval Regional Centre

- Shri K.K. Khakhar, Dept. of Economics, Sasurashtra University, Rajkot
- Shri D.K. Singh, IAS, Deputy Secretary, Ministry of Agriculture, Govt. of India, Krishi Bhavan, New Delhi
- Dr. P.V. Dehadrai, Former Director General, ICAR, New Delhi
- Dr. (Mrs.) N.V. Deshmukh, Head of Zoology Department, Kirty M. Doonguresee College of Arts, Science & Commerce, Mumbai with 25 students
- Dr. S. Pathak, Ex. Director, Central Research Institute for Jute & Allied Fuiber, Nilganj, Barrackpore
- Mr. Mark Nyhof & Mr. Martin Davinoa, Heiploes A.V. Zoutkamp, Holland, Shrimp importers
- Dr. D.C. Bhatt, Head, Dept. of Marine Science, Bhavnagar University with 20 students
- Prof. (Mrs.) K. Pillai, Dept. of Zoology, G.N. Khalsa College, Mumbai
- Dr. P.C. Mankodi (Reader in Zoology), Dept. of Zoology, Faculty of Science, M.S. University, Baroda

Madras Research Centre

- Dr. Mangala Rai, Secretary, DARE & Director General, ICAR, New Delhi
- Shri Sharad Pawar, Hon'ble Minister of Agriculture, Consumer Affairs, Food and Public Distribution
- Dr. Mangala Rai, Secretary, DARE & Director General, ICAR
- Dr. S. Ayyappan, DDG (Fy), ICAR
- Dr. A.D. Diwan, Asst. Director General (M. Fy.), ICAR

Vizhinjam Research Centre

- Mr. M. Kumaran, M.L.A, Kerala

- Dr. M.L. Maheswari, Prof & Head (Retd) Animal Nutrition Div., Veterinary University, Mathura, Uttar Pradesh
- Dr. D. Kapoor, Director, NBFGR, Luknow
- Mr. B.L. Jangira, Director, Finance Dept., ICAR, New Delhi
- Shri P.S. Malhotra, Deputy Commissioner (Fisheries), DAHD&F, New Delhi
- Shri. K.K. Jaswal, Member secretary, National Commission for Enterprises in the Unrecognized Sector, Govt. of India, New Delhi.
- Shri. P.K. Misra, Dy.Registrar, IARI (ICAR), New Delhi
- Shri. H.C. Pathak, Director, Finance (ICAR), New Delhi
- Shri. N. Sarangi, Director, CIFA (ICAR), Bhuvaneswar
- Shri David A. Deptula, Lieutenant General, USAF, Commander, Gen. George C. Kenney Headquarters, USA.

Mangalore Research Centre

- Dr. Z.A. Ansari, Scientist-F, National Institute of Oceanography, Goa
- Dr. A.V. Ramamurthy, Deputy Director General, Geological Survey of India, Mangalore
- Ms. Aarthi Sridhar and Severine Baiale, ATREE, Bangalore
- Dr. R.S. Biradar, Principal Scientist, CIFE, Mumbai
- Dr. D.S. Krishna Rao, Principal Scientist and HOD, Research Division of CIFRI, Bangalore
- Dr. T. Ananda Rao, Karnataka Association of Advancement of Science, Central College, Bangalore
- Dr. Ramachandra Bhatta, Professor and Head, Department of Fisheries Economics, College of Fisheries, Mangalore
- Ms. Anna Godhe, Marine Ecology, Goteborg University, Sweden
- Dr. S. Benakappa, Associate Professor, College of Fisheries, Mangalore
- Dr. Kapila Manoj, Professor, Dept. of Aquatic Biology, Veer, Narmad South Gujarat University, Surat
- Smt. Annie Alexander, AGM, NABARD, R.O. Karnataka, Bangalore
- Dr. S.L. Shanbhogue, Director of Instructions (Retd.), College of Fisheries, Mangalore
- Prof. K.S. Baliga, Consultant, HRD, 'Hema Prabha', Kallianpur

Mumbai Research Centre

- Smt. Sadhana Tripathi, Research Officer, Regional Official Language Implementation Office, Ministry of Home Affairs, Mumbai
- Prof. Asif A. Khan & Dr. Mukhtar A. Khan, Dept. of Zoology, A.M.U., Aligarh
- Dr. V.S.N. Raghavarao, Reader & Head, Anandibai Pradhan S.C. College, Nagothana, Raigad & 21 students

Tuticorin Research Centre

- Shri P.C. Mitra, Principal Chief Engineer, Southern Railway, Chennai
- Shri V. Vanitha, Principal, Police Training College, Tuticorin

Karwar Research Centre

- Dr. Margoj and Mr. Pancham, Staff of Khemarji Mahavidyalaya Sawantwadi, Maharashtra and B.Sc. students
- Prof. Dr. Sanjay Bhagwat, Dr. Manoj Kadam and Prof. V. Harshada along with 36 students from Ruia College, Matunga, Mumbai
- Dr. Kapila Manoj, Gujarat University with 23 M.Sc. students
- Dr. Mahaboob Basha, Dr. M.G. Venktesh, Dr. Usha Anandi and Dr. S. Ramakrishna along with 44 M.Sc. students from Bangalore University

Calicut Research Centre

- Shri C. Saxena, Ex-Governor of Jammu Kashmir, New Delhi
- Dr. Harish Chandra Joshi, Hindi Director (OL)

Minicoy Research Centre

- Dr. A.P. Prem, Consultant General Surgeon, Apollo Hospital, Gream lame, Chennai
- Dr. Jegadheeswaran, Chief Medical Officer, Jipmer, Pondicherry
- Shri P.N. Mohanan, Director, Office of DDGM(SI), Instruments Division, Shivaji Nagar, Pune
- Mr. Farooque, Sports Manager and 20 tourists
- Deputy Collector and Vice Chairperson
- Dr. A.K. Mishra, Scientist, Indian Institute of Remote Sensing, Dehradun, Dept. of Space, Govt. of India
- Dr. Z.A. Ansari, Scientist, NIO and Dr. M.R. Menezes, Scientist, NIO, Goa
- Dr. Lazarus, Institute for Environmental Research Education, Kanyakumari, Tamil Nadu.
- Shri G.S. Fahni, IAS, Director General, Shipping & Secretary, Govt. of India, DDG Shipping, L.G. Ibrahim, Chair person (Dweep)
- Shri M.H. Varma, IPS, DIG of Police
- Smt. Philomina, SRG (Maths) EDCC, Ernakulam and Smt. Ramadevi, K., Master trainer (Aaluva DEO), Trivandrum
- Shri Shaijan, C. George, Advocate, High Court of Kerala
- Dr. M.M. Anwer, Principal Scientist, NAARM, Hyderabad
- Shri Shaji Zacharia, Asst. Gen. Manager, NABARD, Trivandrum
- Shri Shaji A. Thomas, Master Trainer Co-ordination of Teacher, Govt. HSS, Karunagapally, Kollam

कार्यकारी सारांश

अत्यंत गतिमान सागरों में बसनेवाले वन्य प्राकृतिक संसाधनों को संजोने केलिए विज्ञान से पूर्णत: वुली हुई सामयिक डॉटाएं चाहिएं. समुद्री संसाधनों की पकड और पालन के निगाह करते हुए नई प्रौद्योगिकियों से उत्पादन बढ़ाना केंद्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान का मुख्य उत्तरदायित्व है. इस तहत संस्थान ने वर्ष 2005-2006 के दैरान 31 गृहांदर परियोजनाएं, 21 प्रायोजित परियोजनाएं और 9 परामर्श परियोजनाएं कार्यान्वित कीं. वर्ष में चालू अनुसंधान परियोजनाओं का पुर्नगठन और देश के समुद्रवर्ती राज्यों व लक्षद्वीप के समुद्री मछली संसाधनों का मूल्यांकन सी एम एफ आर आइ और सी आइ एफ टी के वैज्ञानिकों ने मिलकर किया. वर्ष 2005 के दौरान संस्थान के 10 प्रभागों और अनुभागों द्वारा किए गए शोध कार्य और उपलब्धियाँ संक्षेप में नीचे दी गई है.

प्रग्रहण मात्स्यिकी

इस वर्ष की समुद्री मछली संपदाओं की वार्षिक पकड अंतिम रूप से 2.28 मिलियन टन आकलित किया था, के मद्दे पकड में 12% घटती हुई. तारली, भारतीय बाँगडा, लेसर सारडीन, क्रोकर्स, फीतामीन, सुरमई, पेनिआइड झींगा और शीर्षपाद मछली जातियों की पकड में हुई कमी इसका कारण है. वर्ष के दौरान बंबिलों, करंजिडों, और नॉन पेनिआइड झींगों की पकड में उपांतिक वृद्धि हुई. कुल पकड का 67% पश्चिम तटों से प्राप्त हुआ. कुल अवतरण का 55% पख मछली, 26% तलमज्जी, 15% क्रस्टेशियाई और 4% कवच मछली थीं. मछली और कवचमछली संसाधनों का पूर्वानुमान करनेलायक सॉफ्टवेयर का विकास किया.

संस्थान को पशुपालन, डेरी और मात्स्यिकी विभाग, कृषि मंत्रालय द्वारा सौंपे अखिल भारतीय समुद्री मात्स्यिकी सेन्सस 2005 के ज़रिए भारत के 8 समुद्रवर्ती राज्यों में स्थित मछुआ ग्रामों, मछुआरों के रहन-सहन व आबादी, मत्स्यन केलिए उपयोग किए जानेवाले यान व उपस्करों पर उपयोगी सूचनाओं का विकास किया. ये सूचनाएं मछली उद्योग के आयोजन केलिए अत्यंत उपयोगी है. मारकोव चेन मोडल पर तैयार किया अनुमान व्यक्त करता है कि भविष्य में तारली, पेनिआइड झींगा और शीर्षपादों की पकड में कमी हो सकती है जबकि 2020 तक पहूँचने पर भारतीय बाँगडों की पकड में 37% बढती प्रत्याशित की जा सकती है. तारलियों की पकड में पिछले वर्ष की तुलना 5.6% की वृद्धि देखी गई. पिछले वर्ष के समान इस वर्ष में दिसंबर के दौरान तारलियों के तरुण और उपवयस्कों ने पश्चजलों में प्रवेश किया. तारलियों के गर्भधान में और 4-5 वर्षों से देखेजाने वाले वर्षा की कमी से, अगले कुछ वर्षों में तारली के स्टॉक में कमी होना, अनुमानित है.

ऐंचावी मछलियों के जीवसंख्या प्राचल पर किए आकलन ने व्यक्त किया कि पश्चिम तटों से इसका कम विदोहन हुआ है. सुरमई मछलियों की पकड में वर्ष के दौरान वृद्धि नहीं हुई है. इसका कारण चेटी जालक्षि के *पोडिवलै* से इनकी शिशु मछलियों की पकड है, ऐसे क्षेत्रों पर बडे जालाक्षिवाले गिलनेटों और काँटा डोरों का उपयोग प्रोत्साहित किया जाना चाहिए.

भारत ट्यूना मछली के शक्य पकड का पूरा उपयोग नहीं कर रहा हैं; अभी तटीय ट्यूना संपदा का 23% और महासागरीय ट्यूना संपदा का 6% का विदोहन होता है. गहरे समुद्रों में मत्स्यन शुरू किए जाने पर अभी स्किपजैक, येलोफिन, लोंगटेल ट्यूना आदि की पकड देखने लगी है जो कि पहले मिल नहीं रहे थे. भारतीय समुद्रों से ट्यूना पकड बढाने के उपाय के रूप में लक्षद्वीप के समुद्रों में विशेषकर अपतट समुद्रों में ड्रिफ्टनेट गिलनेट्टिंग, गहरे सागर श्रिंप ट्रालरों से एकतंतुक लंबी - डोर मत्स्यन शुरू किया जा सकता है. भारतीय बाँगडों की पकड में 2001 से जो कमी दिखाई पडती है, में वर्द्धन प्रत्याशित होती है.

पिछले वर्ष की तुलना में बम्बिल की पकड में उपांतिक बढती देखी गई, कुल पकड में इस से 5.3% योगदान हुआ था. पश्चिम बंगाल के तटों में भी पकड में नैतिक सुधार दिखाया पडा. 2004 की तुलना में फीतामीन की पकड में 13% घटती दिखाई पडने का कारण मत्स्यन प्रयास और मत्स्यन जालों की जालाक्षि आकार कम किया जाना समझना चाहिए. करंजिड जातियों में गिल और ट्रेाल नेट मत्स्यन से *मेगालास्पिस कौरडैला* और ट्राल जाल से *डेकाप्टीरस रुसेल्लि* का अति मत्स्यन देखा गया तो दोनों जालों के ज़रिए *सेलार क्रुमुनोताल्मस* की कम पकड हुई थी.

पिछले वर्ष की तुलना में कुल तलमज्जी मछलियों में उपास्थिमीनों की पकड में 2% की कमी रेकोर्ड की गई. इस में 57% सुरा, 36% रे मछली और 7% स्केट मछली थी. ग्रूपर मछलियों की पकड पिछले वर्ष के समान स्थिर रही जबकि शिंगटियों (कैट फिश) की पकड में 18.5% घटती हुई.

यह व्यक्त हुआ है कि सूत्रपख ब्रीमों का अतिविदोहन होता है. यद्यपि मुल्लनों (सिल्वर बेल्ली) की पकड में 10.4% की वृद्धि हुई तथापि पिछले कुछ वर्षों की पकड पर किए तुलनात्मक अध्ययन व्यक्त करता है कि कुल तलमज्जी जातियों में इसकी पकड प्रवणता नीचे की ओर ही है. अखिल भारतीय क्रेाकर मछली पकड में घटती 5.5% के बराबर रही. वर्ष 2005 में पोम्फ्रेट का अखिल भारतीय अवतरण 44, 190 ट था जिस में 58% सिलवेर पाम्फ्रेट 34% ब्लाक पाम्फ्रेट, और 8% चीनी पाम्फ्रेट थे. मलबार सोल *साइनोग्लोसस माक्रोस्टोमस* का उत्पादन और खडी जैवमात्रा लग-भग समान देखा गया जो कि इस जाति का भारी विदोहन सूचित करता है.

यह देखा गया कि मिनिट्रालर, *तल्लुवलै,* डाल जाल और स्टेक जाल के ज़रिए मछलियों, झींगों व कर्कटों के तरुणों का सर्वनाश होता है. चिंगट मात्स्यिकी केलिए ऐसा ट्राल मत्स्यन खतरनाक साबित हुआ है. इसे रोकने को जलाक्षि आकार पर कडा विनियमन आवश्यक है. कृत्रिम आवास निर्माण करके बनायी आवास व्यवस्था में काँटा-डोर मत्स्यन से अच्छी पकड मिली थी.

भारत के मछली अवतरण केंद्रों में उपपकड या अनुपयोगी मछली के रूप में अवतरण की गई संपदाओं में सियनिड़ों, मुल्लनों, सूत्रपख ब्रीमों, गोबिडों, असेटसों, केकडों, नॉन-पेनिआइड झींगों के तरुण और मोलस्कों के कवछा भारी मात्रा में थी. कुल पकड में इनका अनुपात चेन्नई में 4.9% था तो विशाखपट्टणम में 34.7%. देश के समुद्रवर्ती राज्य व संध राज्य क्षेत्र. केरल, कर्नाटक, गुजरात, मुंबई, गोवा, तमिलनाडू, आंध्रप्रदेश, उड़ीसा, पश्चिम बंगाल, पेडिंछोरी और लक्षद्वीप के मात्स्यिकी संसाधनों, जातिवार संघटनों, मुख्या जातियों की जीवसंख्या गतिकियों, मत्स्यन यानो व संभारों, मछुवारों की समाज-आर्थिक स्थितियों और विपणप मुद्दों पर किए मूल्यांकन अध्ययन ने इन पर मूल्यवान सूचनाएं जुटाने में बहुत सहायक निकली. ये सूचनाएं इन समुद्रवर्ती राज्यों व संघराज्य क्षेत्रों के मात्स्यिकी संबंधी प्रबंधन नितियाँ खींचने में सक्षम हैं.

संस्थान के वैज्ञानिकों ने उत्तर पश्चिम तट के 26 वर्गों और मान्नार पारिस्थितिक तंत्र के 32 वर्गों की, आवास व्यवस्था और अशन रीतियों के आधार पर, पारिस्थितिकी वर्गीकरण किया. इनके इकोपाथ (ECOPATH) प्राचल जैसे आहार संघटन, जैवमात्रा आकलन और स्थिति अनुपात भी आकलित किया. समुद्री उत्पाद निर्यात विकास प्राधिकरण द्वारा निधिबद्ध एक परियोजना में उत्तर पश्चिम और दक्षिण पूर्व तटों में मछुवारों को महाचिंगट मात्स्यिकी मत्स्यन में अनुवर्त करने की रीतियों पर अवबोध जगाने का कार्यक्रम आयोजित किया.

समुद्री संवर्धन (जलकृषि)

तीन चित्तीवाली डामसेल मछली *डासिलस ट्रैमाकूलाटस* और नीली डामसेल मछली *पोमासेन्ट्रस सियेरुलस* का स्फुटनशाला (हैचरी) उत्पादन का मानकीकरण किया गया. इस तकनीक में इन्हें खिलाने केलिए हरितपानी तकनीक और पहले दो हफ्तों में कोपिपोडों के नॉप्लि और इसके बाद नए स्फुटित *आरटीमिया* नॉप्लि का उपयोग किया. कोचीन के हैचरी में क्लाऊन मछली पेर्कुला का सफल प्रजनन और उत्पादन तकनीक का मानकीकरण किया. संयोजित सूक्ष्म काइयों से संपुष्ट किए *आरटिमिया* नाप्लि से खिलाने पर इनके डिंभकों की अतिजीवितता दर अच्छी देखी गई.

वर्ष 2005 के दौरान *पेनिअस सेमिसुलकाटस* के 4.3 मिलियन पश्छाडिंभकों और केकडा *पोर्ट्नस पेलाजिकस* के 13449 शिशुओं का समुद्र रैंचन मान्नार की खाडी में किया. भारत में पहली बार सीपी पाफिया मलबारिका और मुक्ता शुक्ति *पिंक्टाडा फ्यूकाटा* का रिमोट सेटिंग किया गया.

एकल मुक्ता शुक्तियों से बहुरूपी मेबे मोती निर्माण तकनीक विकसित किया. शुक्ति एबलोन के दौलीनुमा झिल्ली (मान्टिल टिश्यू) से पहली बार *पात्रे* मोती संवर्धन किया गया. शंबु के आयासहीन फसलकाट केलिए एक मसल डीक्लंपर का विकास किया. सान्ड लॉबस्टर (रेत महाचिंगट) के रसायन स्वीकार्याता (कीमोरिसेप्शन) बढाने केलिए सीपी मांस अनुयोज्य देखा गया. इस परीक्षण में दोन्नस *ओरियेन्टालिस* और इसके नर पहले परिपक्व हुए और पानिलूरस होमारस फिल्लोसामा VIII ने स्फुटन के बाच 42 दिवसों के अंदर पहली बार परिपक्व हुए.

कापाफैक्रस नामक समुद्री शैवाल की खेती पर मंडपम और कोचीन में किए परीक्षणों ने अच्छा फसल काट दिया. समुद्री शैवाल के साथ मोनोडॉन झींगे का पालन करने पर रोगमुक्त (वैरल) पाया गया. कापाफैकस से अनुकूलतम मात्रा और उच्छा गुणवाले कारागीनन का निकर्षण करने की रीति का मानकीकरण किया.

हरित शंबु और समुद्री शैवाल का संयोजित पालन सफल देखा गया. वर्ष के दौरान संस्थान के समुद्री संवर्धन प्रभाग ने राज्य सरकार और अन्य जलकृषि विकास अभिकरणों के सहयोग से शंबु, खाद्यशुक्ति और समुद्री शैवाल पालन पर कई निदर्शन और प्रशिक्षण कार्यक्रम आयोजित किए.

पर्यावरणीय और जैवविविधता अध्ययन

देश के पूर्वी और पश्चिमी तटों की पर्यावरणीय डॉटाओं के अजैविक और जैविक अभिलक्षणों पर किए अवलोकन ने इन में विचारणीय परिवर्तन सूचित किया. समुद्री जीवों में बयोअक्युमुलेशन और बयोमागनिफिकेशन पर किये अध्ययन में इन जीवों में विशेषकर उच्छा पोषिक तल में जीनेवाले मछलियों और डालफिनों में भारी धातु काडमियम का उच्छा बयोमागनिफिक्रेशन कारक दिखाया दिया. औद्योगिक क्षेत्र के निकटतम पानी के अवसाद में विषालू भारी घातुएं भारी मात्रा में मैजूद थी.

पिछले वर्ष की तुलना में उडीसा के तटों में कच्छप *ओलिव रिडले* का नीडन अधिक संख्या में हुआ था. समुद्र कृषि केलिए अनुयोज्य क्षेत्र निर्धारण केलिए भौगोलिक सूचना प्रणाली (जी आइ एस) के ज़रिए किए अध्ययन में महाराष्ट्र और दक्षिण कर्नाटक में 3, केरल में 18 और तमिलनाडु में 6 क्षेत्र अनुयोज्य पाए गए.

महासागरीय विकास विभाग की प्रायोजित परियोजना के अधीन समुद्री सस्तनियों के दर्शनीय स्थान पर एफ ओ आर वी सागर संपदा नामक परीक्षण पोत के ज़रिए किए पर्यटनों में अरब सागर और बंगाल की खाडी के 118 स्थानों में तिमिगणों (सीटेश्या) की उपस्थिति रेकार्ड की. फरवरी 2006 को गंगोली, माल्प और माँग्लूर में अवतरित 15 डॉलफिनों के आंत्रनालि वस्तु विश्लेषण किया. चेन्नई से प्राप्त डॉलफिनों के आंत्र में भारी धातु और कीटनाशी विषैले पदार्थों की मात्रा अन्य स्थानों की तुलना में अधिक थी. धातु-विश्लेषण में काडमियम को चेडकर लगभग सभी धातुओं ने जिगर > वृक्क > ऊतक संबंध दिखाया जबकि काडमियम ने वृक्क>जिगर>ऊतक संबंध. संस्थान ने तिमिगणों का डी एन ए बैंक का विकास किया. बोट्टिलनॉस डॉल्फिन, स्पिन्नर डॉल्फिन, इन्डोपसिफिक हम्पबाकड डॉलफिन, रिसोस डॉलफिन, फिनलेस पोरपोइस के 46 अलग-अलग अधिमिलनों से यह ढूँढ निकाला था. जेन बैंक में 20 माइटोकोन्ड्रियल डी एन ए सीक्वेनस का निक्षेप किया. फलस्वरूप खतरे में पडे इन 7 डालफिनों के चेटा सा भाग मिलने पर पूरे जीव को देखे बिना इनका पहचान साध्य हो गया है.

मौसमी परिवर्तन से भारतीय मात्स्यिकी में होनेवाले प्रभाव, अनुकूलन और सहनीयता पर पिछले करीब 50 वर्षों के डाटाओं के माध्यम से किए अध्ययन ने समुद्रोपरितल तापमान और पकड में क्षेत्रवार सह संबंध सूचित किया; अत: उत्तर पूर्वी क्षेत्र में यह प्रतिकूल था तो दक्षिणपूर्वी और दक्षिण पश्चमी तटों केलिए अनुकूल. तापमान से प्रवाल झाडियों का विरंजन और मछली अंडो और डिंभकों का वर्द्धन भी रोकोर्ड किया.

गल्फ ऑफ मान्नार बयोस्फियर रिसर्व (जी ओ एम बी आर) के संसाधनों पर किए सर्वेक्षणों ने व्यक्त किया कि मानोली में उच्छा जैवविविधता है और सब से कम अनैपार द्वीपों में. भारत के पूर्वी और पश्चिमी तटों में स्थित अवतरण केंद्रों से 102 कुटुम्बों में आनेवाली 300 पख मछलियों का पहचान और फोटोकरण करके उनके गणनीय और आकृतिमान अभिलक्षणों का प्रलेखन किया. संस्थान में स्थापित समुद्री जैवविविधता म्यूज़ियम में साधारण, असाधारण विशेष और विरल नमूनों का संग्रहण, परिरक्षण और प्रलेखन किया.

जैव प्रौद्योगिकी

मैंग्रोव अनूप से फाइटेस का उत्पादन करने वाले बासिलस के चार विभेदों का विलगन किया गया. बासिलस *लिछोनिफोर्मिस* से खाद्य पूरकों के प्रति पोषकीय प्रभावों का निषेध करनेवाले आसिड फोस्फटेस का शोधन किया गया. *पेनिअस सेमीसल्केटस* केलिए रूपाइत खाद्य में न्यूनतम फिश मील प्रति/कि ग्रा में 150 ग्राम देखा गया.

पानुलिरस होमारस के आहार में 3% स्तर में कीमो - अट्राक्टन्ट सोयालेसितीन जोडने पर 74.4% की उच्छा वृद्धि थ्र और 1.44 की कम खाद्य परिवर्तन दर देखी गयी. समुद्री अलंकारी मछलियों से आठ और मुक्ता शुक्ति डिंभकों से 10 बैक्टीरिया रोगजनकों का विलगन किया गया. जाति विशेषक प्रारम्भकों को उपयुक्त करके *विब्रियो पाराहीमोलिटिकस* का आण्विक पहचान किया जा सका. समुद्री संवर्धन के तालाबों से संग्रहित *ऐरोमोनास हाइड्रोफिला* के विलगनों में विचारणीय मात्रा में आनुवंशिक विविधता दिखायी पडी. चिंगट किसानों को सफेद चित्ती रोगकारक विषाणु (WSSV) और मोनोडोन बाकुलोवाइरस केलिए पी सी आर आधारित निदान सेवाएं प्रदान की गयी.

वी. एन्गिवल्लेरियम के उग्र विभेद से, तैयार की गयी टीका द्वारा ग्रूपर *एपिनिफेलस मल्बारिकस* में संरक्षित प्रतिरक्षा विकसित की गयी. अल्वा फासिएटा से निकाले गए पी बी एस (pH 7.0) में हेक्सेन बेनसीन के बाइमोलिक्यूल फ्राक्शन (60:40%) में *बि. एल्गिनोलिटिकस* के विरुद्ध उच्चतम प्रतिजैविक गतिविधि देखी गयी. *हिपनिया म्यूसिफोर्मिस* के मेथनोल सार ने *स्यूडोमोनास ऐरुगिनोसा* और *बी. एल्गिनोलिटिकस* की रोगजनकता का संदमन किया.

बम्बिल के आनुवांशिकी पर किए नमूने अध्ययन में पश्चिम बंगाल से प्राप्त स्टॉक में यह दिखाया पडा कि उत्तर पश्चिम और उत्तर पूर्वी तटों के नमूनों ने मुम्बई की अपेक्षा उच्छतम आनुवंशिक विभिन्नता दिखायी. *लूस शेल सिन्ड्रोम रोग* से ग्रसित *पेनिअस* मोनोडोम ने निष्क्रियता, कम बढ़ती, अधिक खाद्य परिवर्तन अनुपात, अरुचि और कवचों के मृदूकरण से नेक्रोटाइसिंग हेपाटोपान्क्रियाटिस (NHP) रोग का लक्षण दिखाया.

विस्तार एवं आर्थिकी

समुद्री संसाधनों के मूल्य स्वभाव का निर्धारण करने पर यह व्यक्त हो गया कि आंतरिक विपणन व्यवस्था में उच्छा गुणतावाली मछलियों और निर्यातयोग्य मछलियों का मूल्य तुलनात्मक दृष्टि से कम या स्थिर था. सूनामी के बाच के समय को चेडकर अन्य समय में सभी मछलियों के औसत मूल्य में वृद्धि हुई थी. मत्स्यन एककों के आर्थिक निष्पादन का आकलन किया गया. एक दिवसीय और बहुदिवसीय आनायकों के प्रकार्य का विश्लेषण करने पर आगामी वर्षों में बहुदिवसीय मत्स्यन प्रचालन वर्द्धित होने की साध्यता व्यक्त हो गयी.

कृषि प्रौद्योगिकी सूचना केंद्र ने प्रौद्योगिकीय उत्पादों, प्रकाशनों, रोगनिदान सेवाओं और प्रयोगशाला परीक्षणों से 1.27 लाख रुपए का आय जगाया.

प्रकाशन, नई परियोजनाएं और मान्यताएं

संस्थान के कार्मिकों ने प्रमुख पत्रिकाओं में कुल 35 अनुसंधान लेखों का प्रकाशन किया है जिनमें 11 विदेशी पत्रिकाएं 38 तकनीकी लेख और 84 लेख संगोष्ठी/परिचर्चाओं में प्रकाशित है. संस्थान ने वर्ष 2005 के दौरान उत्कृष्ट राजभाषा कार्यान्वयन केलिए राजर्षि टंडन पुरस्कार जीत लिया. संस्थान ने केरल सरकार के मात्स्यिकी विभाग द्वारा आयोजित अखिल भारतीय अक्वा शो - 2006 में भाग लिया और उत्कृष्ट समुद्री जलजीवशाला पुरस्कार प्राप्त किया, तिरुवनंतपुरम में 9-18 सितंबर, 2005 के दौरान आयोजित अक्वा शो में उत्कृष्ट मराइन स्टाल का पुरस्कार भी प्राप्त किया. पंजरा पालन, ट्यूना संपदाएं, गभीर समुद्री संपदाएं, मछली बीज उत्पादन और जलकृषि स्वास्थ्य प्रबंधन विषयों पर छह नई परियोजनाओं केलिए पशु विज्ञान मंत्रालय, जैव प्रौद्योगिकी विभाग, महासागर विकास विभाग और भारतीय कृषि अनुसंधान परिषद नेट वर्क का अनुमोदन प्राप्त हुआ है.

प्रशिक्षण एवं शिक्षा

शिक्षा कार्यक्रम के अंदर, वर्ष 2005 के दौरान नियमित छात्रों और निधिबद्ध परियोजनाओं के वरिष्ठ अनुसंधान अध्येताओं को जोडकर 10 शिक्षार्थियों को पी एच.डी उपाधि प्रदान की गयी. रिपोर्टाधीन वर्ष में कृषि विज्ञान केंद्र ने कुल 97 प्रशिक्षण कार्यक्रम और 100 विभिन्न पाठ्यक्रमों का आयोजन किया.

राजस्व

संस्थान ने 100 लाख रुपए के लक्ष्य के मद्दे 105.5 लाख रुपए का राजस्व जगाया.

Acronyms Used

ADAK	Association for Development of Aquaculture in Kerala
ATIC	Agricultural Technology Information Centre
BFFDA	Brackishwater Fish Farmers Development Agency
CARI	Central Agricultural Research Institute
CGP	Competitive Grants Programme
CIBA	Central Institute of Brackishwater Aquaculture
CIFA	Central Institute of Freshwater Aquaculture
CIFE	Central Institute of Fisheries Education
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
CoF	College of Fisheries, Mangalore
DBT	Department of Bio-Technology
DOD	Department of Ocean Development
DST	Department of Science & Technology
E	Exploitation Rate
FAO	Food and Agricultural Organisation
FSI	Fishery Survey of India
GAU	Gujarat Agricultural University
GOPL	GMR PSEG Operations Private Limited, Mangalore
IASRI	Indian Agricultural Statistics Research Institute
ICAR	Indian Council of Agricultural Research
IFS	International Foundation of Science
IGIDR	Indira Gandhi Institute of Development Research
IOTC	Indian Ocean Tuna Commission
ISD	Information System Development
IVLP	Institution Village Linkage Programme
KIOCL	Kudremukh Iron Ore Company Limited
KKV	Konkan Krishi Vidhyapeeth
MM	Mission Mode
MOE&F / MEF	Ministry of Environment & Forest
MPEDA	Marine Products Export Development Authority
MRPL	Mangalore Refineries and Petrochemicals Limited
MSY	Maximum Sustainable Yield
NAARM	National Academy of Agricultural Research Management
NABARD	National Bank for Agricultural and Rural Development
NATP	National Agricultural Technology Project
NBFGR	National Bureau of Fish Genetic Resources
NGOs	Non-Governmental Organisations
NIO	National Institute of Oceanography
PSR	Production Systems Research
RC	Research Centre
RGCA	Rajiv Gandhi Centre for Aquaculture
SEAFDEC	South East Asian Fisheries Development Centre
SFDs	State Fisheries Departments
TANUVAS	Tamil Nadu Veterinary and Animal Science University
WFC	World Fish Centre
Z	Mortality Rate

Central Marine Fisheries Research Institute

Research Locations

Headquarters - COCHIN
PO Box 1603, Ernakulam North PO
Cochin 682018, Kerala State
Tel: 0484 2394867, 2394357, 2394795
Fax: 0484 2394909
Email: mdcmfri@md2.vsnl.net.in

Regional Centre - VERAVAL
Matsya Bhavan, Bhidia
Veraval 362269, Gujarat State
Tel : 02876-232649, Fax : 02876-231865
Email : cmfrivrl@sancharnet.in

Regional Centre - MANDAPAM
Marine Fisheries PO
Mandapam Camp 623520
Tel: 04573 241433, 241456
Fax: 04573 241502
Email: md_offinch@sancharnet.in

Regional Centre - Visakhapatnam
Pandurangapuram, Ocean View Layout,
Visakhapatnam 530003
Tel : 0891 2543154, 2543793
Fax : 0891 2543154
Email : cmfrivsp@sancharnet.in

Research Centre - MUMBAI
2nd Floor, CIFE (Old campus)
Fisheries University Road,
Versova, Mumbai - 400 061
Tel/Fax: 022 26320824 (P)
26392795
Email: cmfrimumbai@mtnl.net.in

Research Centre - KARWAR
PB No.5, Karwar,
North Kanara, Karnataka
Tel: 08382 221371, 226264
Email : cmfrikwr@sancharnet.in

Research Centre - MANGALORE
PB No.244, Bolar, Mangalore 575001
Tel: 0824 2424152
Fax: 0824 2424061
Email: cmfrimng@sancharnet.in

Research Centre - CALICUT
West Hill PO, Calicut 673005
Tel: 0495 2382033, Fax: 0495 2382011
Email : crc_cmfri@sancharnet.in

Research Centre - VIZHINJAM
P.B. No. 9, Vizhinjam PO,
Thiruvananthapuram 695521
Tel: 0471 2480224, Fax: 0471 2480324
Email : cmfrivzm@eth.net

Research Centre - TUTICORIN
115, NK Chetty Street, Tuticorin 628001
Tel: 0461 2320274, Fax: 0461 2322274
Email: ttn_trccmfri@sancharnet.in

Research Centre - MADRAS
75, Santhome High Road,
Raja Annamalaipuram,
Chennai 600028
Tel: 044 24617264, Fax: 044 24617290
Email: chfish@vsnl.com

Research Centre - MINICOY
UT of Lakshadweep 682559
Tel : 04892 - 222228
Fax : 04892 - 222228

www.cmfri.com